Louisville Metro Department of Public Health and Wellness

Mosquito Control Program

2008 Annual Report

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2008 Annual Report

The primary goal of the Mosquito Control Program is to reduce the risk of any mosquito borne disease outbreak in our community, whereas our secondary goal is to reduce the number of nuisance mosquitoes. Nuisance mosquitoes can cause severe annoyance, affecting quality of life, recreation and business. This program uses an integrated pest management system to reduce and prevent mosquito breeding. The program is composed of several components: pretreatment, mosquito population surveillance, disease surveillance, sampling, source reduction, education, complaint investigation, biological control, larvicide and adulticide application.

The Mosquito Control Program is a seasonal program. In 2008, the mosquito season began in late March and continued in full operation until early October, during which five Environmental Health Specialists and five seasonal employees were assigned to the program. One Environmentalist remained in the program during winter months. This report discusses the activities conducted during the 2008 mosquito season.

HISTORICAL PERSPECTIVE

Historically, Metro Louisville has been an area where mosquito control activities were essential to the growth of the community. During the 1870s and 1880s, malaria and yellow fever epidemics struck Kentucky, causing many illnesses and deaths. The earliest efforts to control mosquito borne diseases focused on the draining of wetlands and floodplains. Malaria and yellow fever made this imperative to public health and land development; however, the subsequent development resulted in citizens living in low lying, flood and mosquito prone areas.

Because many mosquitoes prefer highly organic water, like sewage overflows to lay their eggs, the expansions of the sewers through the county helped decrease the population of these mosquitoes. Construction of the floodwall helped decrease the mosquito population by preventing and limiting the Ohio River from flooding the community and therefore preventing areas of standing water.

In 1956, a St. Louis Encephalitis (SLE) outbreak occurred in Louisville. This outbreak produced 110 confirmed positive illnesses, resulting in 13 deaths. In 1975, 21 residents of Jefferson County contracted SLE with 2 fatalities. Typically SLE is identified in 1:100 cases, resulting in a much higher percentage of the population actually infected with the disease. More recently, in 2002, the appearance of West Nile Virus in Metro Louisville caused 28 illnesses and 2 deaths.

Summer Worker Treating Catch Basin

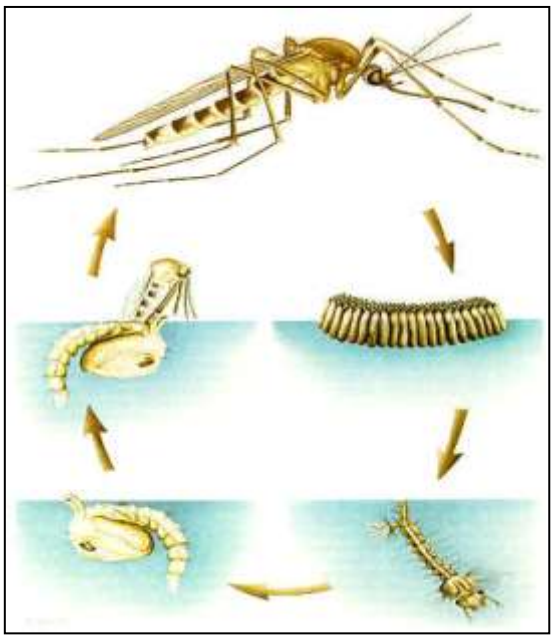
The Mosquito Control Program was established under the direction of the Louisville and Jefferson County Health Department in 1957. Early work by the program controlled mosquito populations

through drainage improvement and pesticide application. The mosquito control program worked with other public agencies to correct ditch lines, drain swamps and wet woods, and established positive drainage throughout the county. For example, in 1960, the mosquito control program's accomplishments included drainage improvement of 781,590 linear yards of ditch line, the draining of 2,183,629 square yards of flooded land and the digging of 31 new ditches. Although the approach to source reduction has changed as part of the mosquito control program (Public Works and MSD have taken on the responsibility for these functions) the positive effect it has on reducing mosquito populations cannot be understated.

The continuing expansion of residential and commercial development throughout the county has also aided in the elimination of mosquito breeding sites. Currently the Mosquito Control Program staff conducts drainage inspections in association with developers and other public agencies. When corrective action is necessary to improve drainage, the program staff will issue orders to the responsible party or refer the problem to the proper agency.

MOSQUITO BIOLOGY AND DISEASE

Mosquitoes are found all over the world, except in Antarctica. These two-winged insects belong to the order Diptera. Members of the genera *Anopheles*, *Culex*, and *Aedes* are most commonly responsible for bites in humans. There are approximately 170 species of mosquitoes in North America alone[1]. To develop, mosquitoes require an environment of standing water. As a group, they have adapted to complete their life cycle in diverse aquatic habitats, including fresh water; salt-water marshes; brackish water; or water found in containers, old tires, or tree holes. The life cycle of the mosquito has four stages. The female mosquito lays her eggs, up to several hundred at a time, on the surface of the water or in an area subject to flooding. Eggs of some species can withstand months to years of desiccation, remaining viable until the right conditions for hatching occur. The eggs of most species hatch in 2 to 3 days, and the larvae feed on organic matter in the water for several days until they change into pupae. The pupae live at the surface of the water for 2 to 3 days before metamorphosing into adult mosquitoes. This life cycle usually takes place in 7-10 days or more quickly during extreme summer heat[1].



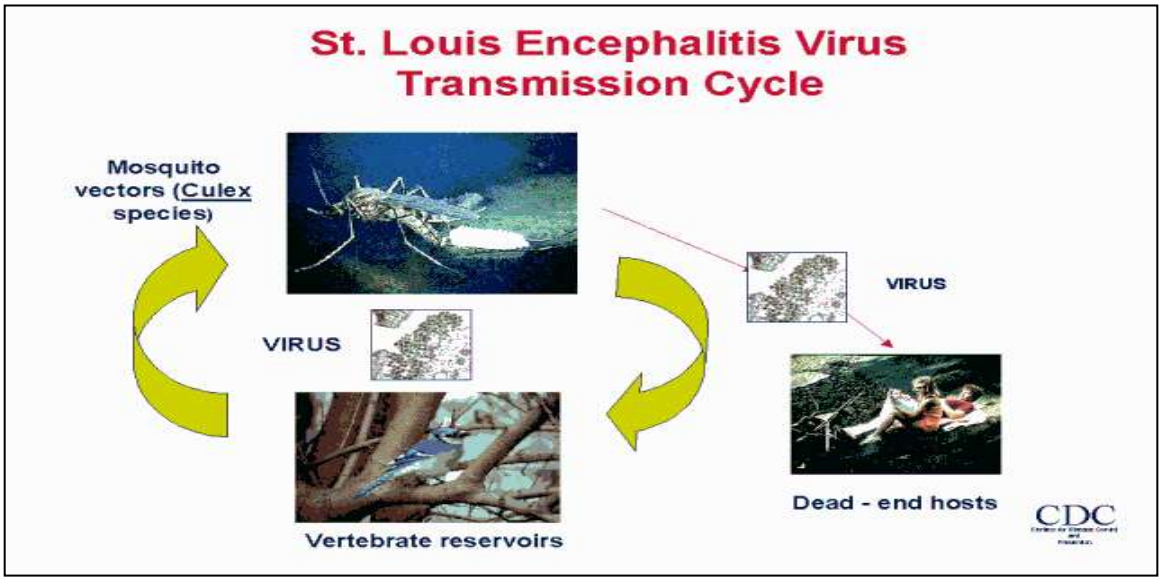
Only female mosquitoes bite. Male mosquitoes feed primarily on flower nectar, whereas female mosquitoes require a blood meal to produce eggs[1, 5]. They usually feed every 3 to 4 days and in a single feeding a female mosquito can consumes more than its own weight in blood. Certain species of mosquitoes prefer to feed at twilight or nighttime; whereas others bite mostly during the day[1, 5].

Some mosquito species are zoophilic (preferring to feed on animals) and others are anthropophilic (showing a preference for human blood). In some mosquito species, seasonal switching of hosts provides a mechanism for transmitting diseases from animal to human. Mosquitoes obtain the viral agent from feeding on an infected host. The viral agent then multiplies within the mosquito and is transmitted during subsequent bites[5].

The predominant public health concern with a large mosquito population is the increased risk of a mosquito borne disease transmission. Encephalitis is a danger associated with mosquito borne arbovirus. Encephalitis is an inflammatory disease involving the nervous system which can be fatal[5].

There are five major types of arboviral encephalitis in the United States: St. Louis Encephalitis (SLE), Eastern Equine Encephalitis (EEE), Western Equine Encephalitis (WEE), La Crosse Encephalitis (LAC), and West Nile Virus (WNV). The diseases are normally infections of birds or small mammals and are transmitted to humans through infected mosquito bites.

St. Louis Encephalitis was the most common mosquito-transmitted human pathogen in the U.S. before the detection of West Nile Virus. While periodic SLE epidemics have occurred in the Midwest and Southeast, SLE virus is distributed throughout the lower 48 states. Since 1964, there have been 4,658 confirmed cases of SLE in the U.S., with 68 cases in Kentucky. A single case was reported in 2006. St. Louis Encephalitis has a 3-30% fatality rate, depending greatly on patient's age. In the case of SLE the bird is only infective for five days; however the mosquito will remain so for the entire period of its life[1, 3, 5]. No cases of SLE were reported in Kentucky for 2008.



Eastern Equine Encephalitis (EEE) is caused by a virus transmitted to humans and equines by the bite of an infected mosquito. Eastern equine encephalitis virus creates mild to severe neurological deficits in survivors. There have been 250 confirmed cases in the U.S. since 1964 and currently occurs along the eastern seaboard, the Gulf Coast and some inland Midwestern locations of the United States. During 2008 no cases of this disease were reported in Metro Louisville, but one veterinary case of this disease was reported in Kentucky. Approximately 35% of all people with clinical encephalitis caused by EEE will die and of those who recover many will suffer permanent brain damage[1, 3, 5]. EEE has been detected in Kentucky and is a particular concern for the horse industry. Human cases are usually preceded by those in horses and exceeded in numbers by horse cases, therefore creating a good surveillance tool. Eastern Equine Encephalitis is usually fatal in horses[5]. Several species of mosquitoes native to Metro Louisville are capable of transmitting EEE.

Western Equine Encephalitis (WEE) was first isolated in California in 1930 and remains an important cause of encephalitis in horses and humans in North America, mainly in western parts of the USA and Canada. There have been 640 documented human cases of WEE in the United States. Most WEE infections are asymptomatic or present as mild, nonspecific illness. Children, especially those under 1 year old, are affected more severely than adults. The mortality rate is about 3%[1, 5]. Although not normally considered a risk in Kentucky, several native mosquito species are capable of transmitting the disease.

La Crosse Virus cycles in woodland habitats between the tree hole mosquito (*Aedes triseriatus*) and mammal hosts (chipmunks, squirrels)[1, 3]. If the female mosquito is infected, she may lay eggs that carry the virus, and the adults coming from those eggs may be able to transmit the virus to chipmunks and to humans. It has a less than 1% fatality rate in humans. Severe disease occurs most commonly in children under the age of 16 and is characterized by seizures. According to the CDC, approximately 70 cases are reported per year. Most cases occur in children under 16 years of age[1, 3].

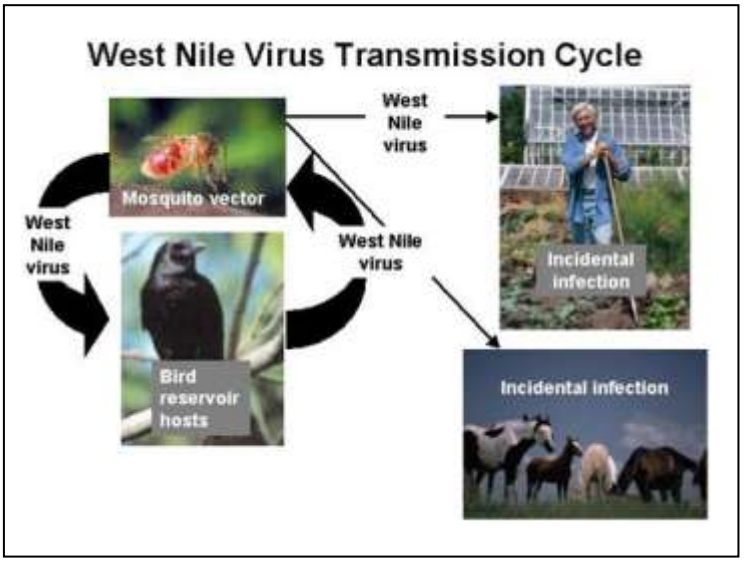
Historically, most cases of LAC encephalitis occur in the upper midwestern states (Minnesota, Wisconsin, Iowa, Illinois, Indiana, and Ohio). Recently, more cases are being reported from states in the mid-Atlantic (West Virginia, Virginia and North Carolina) and southeastern (Alabama and Mississippi) regions of the country. It has long been suspected that LAC encephalitis has a broader distribution and a higher incidence in the eastern United States, and may be under-reported.

There have been 21 reported human cases of La Crosse in Kentucky from 1964-2003. Recently, one case was reported in 1999, two cases in 2000, two in 2002, three in 2005, and one in 2008. In Metro Louisville the primary vector, the tree hole mosquito, can be found in abundance along with *Aedes albopictus* also suspected of transmitting La Crosse.

WEST NILE VIRUS

West Nile Virus (WNV) is the most recent emergent disease to impact the Louisville area. It has been observed in North America since August of 1999 and was first observed in this community two years later in 2001. This disease continued, in subsequent years, to spread across the United States. This disease is now considered endemic. Continued vigilance will be necessary to combat this disease and protect the metro population. Domestic and migrating birds are the primary carriers of the disease[5]. Although birds, particularly crows and blue jays, infected with WNV can die or become ill, most infected birds do survive. This disease appears to be transmitted much the same way as St. Louis encephalitis, primarily by the common house mosquito (*Culex pipiens*). Several other mosquitoes including the floodwater mosquito (*Aedes vexans*) are known carriers of the virus, but do not pass it on effectively. Both *Culex pipiens* and *Aedes vexans* are plentiful in Metro Louisville.

Onset of West Nile Virus occurs after a 5-15 day incubation period. Patients with milder forms of the disease may show little or no symptoms. More severe cases exhibit flu like symptoms and may progress into a severe human meningoencephalitis (inflammation of brain and spinal cord), particularly in elderly patients. The severe form of the disease has a 3%-15% mortality rate.



The Centers for Disease Control tests and tracks blood donations for West Nile Virus. In 2008, a total of 173 presumptively viremic blood donors (PVD) were reported to CDC through state and local health departments[2]. A PVD is a person who was asymptomatic at the time of donating blood (people with symptoms are deferred from donating), but whose blood tested positive in preliminary tests for the presence of West Nile virus. Two PVDs were identified from Kentucky in 2008.

Nationwide, the incidence of West Nile virus in 2008 was observed in birds, mosquitoes, horses and humans. West Nile Virus has been detected in all the continental United States. The total number of WNV cases nationally was less than half of the previous year. There were 1,370 cases for the year including 37 deaths associated with WNV as of December 16, 2008. In Kentucky , three human cases of WNV were reported; however, none of these resulted in a death. California had the highest number of cases (411) by state, followed by Arizona (109) and Mississippi (99). California accounted for 30% of the national cases of West Nile Virus in 2008. The overall number of cases decreased from 2007 to 2008, the disease mortality continued to decline from 3.6% (2006) to 3.1% (2007)[2] then to 2.7% (2008).

Other Mosquito Borne Diseases:

Dengue

Dengue is a viral disease transmitted from person to person by mosquitoes and is found mainly in the tropics[1]. Although usually a nonfatal disease, the acute infection can lead to a hemorrhagic fever. There is a small, but potentially significant, risk for dengue outbreaks in the continental United States. Dengue transmission has been detected in south Texas six times between 1980 and 2005. There are two competent mosquito vectors present in Metro Louisville (e.g., *Aedes aegypti* and *Aedes albopictus*) and under certain circumstances these vectors could transmit dengue viruses[3]. These vectors have been associated with dengue epidemics in Northern Mexico and Hawaii. In the United States, there have been 3,806 suspected cases of imported dengue reported from 1977-2004.[3]

Yellow Fever

Yellow Fever is a viral disease transmitted from mosquitoes to humans and it caused frequent epidemics in the 18th and 19th centuries throughout the United States. Outbreaks of the disease were also reported in Kentucky during the 1800's. *Aedes aegypti* is a mosquito present in Louisville and associated with urban Yellow Fever in the tropics[1, 3, 5]. The disease still occurs in Africa and South America and threatens to reemerge in the U.S.

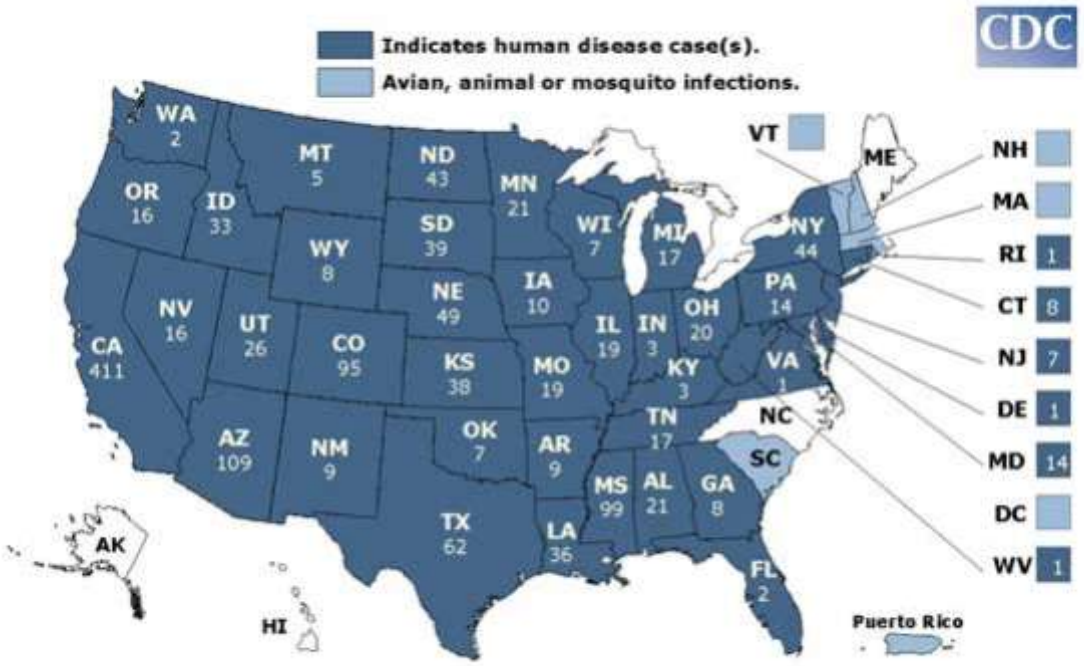
Malaria

Malaria is a serious, often fatal, disease caused by a parasite of the genus *Plasmodium*[5]. Humans get malaria from the bite of a malaria-infected mosquito. It was eliminated as a major problem in the United States by the early 1950's: however, *Anopheles quadrimaculatus*, the primary mosquito responsible for transmitting malaria, can be found abundantly in Metro Louisville[1].

About 1,200 cases of malaria are diagnosed in the United States each year, and between 1998 and 2001 over fifty-five hundred cases of malaria were diagnosed. There were twenty-nine cases of malaria reported in Kentucky between 1997 and 2000 . In 2005 there were 11 cases reported in Kentucky and three (3) of these were in Metro Louisville. Four cases were reported in Kentucky in 2006.

Most malaria cases in the United States are in immigrants and travelers returning from malaria-risk areas; however, a few cases result from blood transfusions, are passed from mother to fetus during pregnancy, or are transmitted by locally infected mosquitoes. Worldwide Malaria continues to be one of the greatest killer of humans[1].

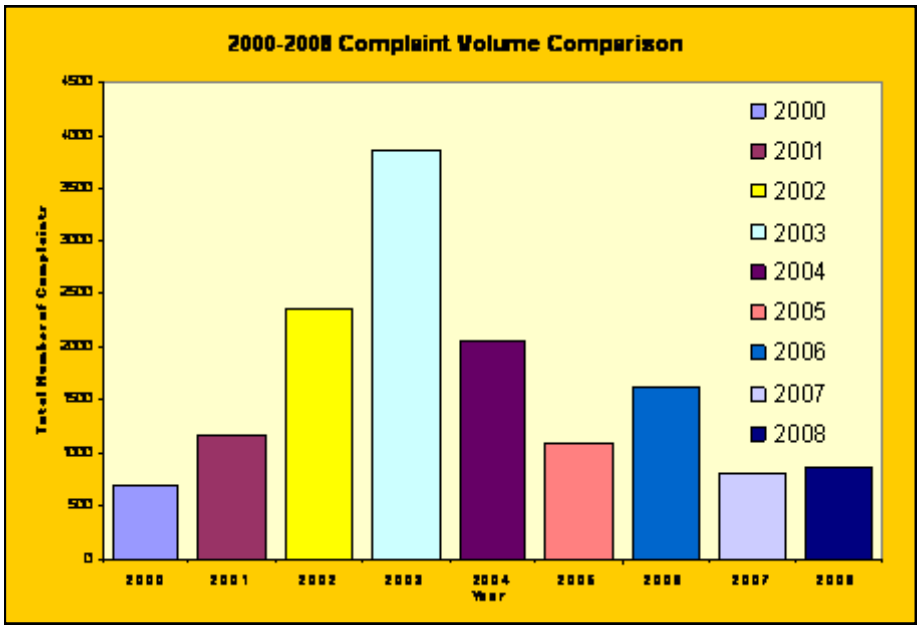
National 2008 Incidence of West Nile Virus

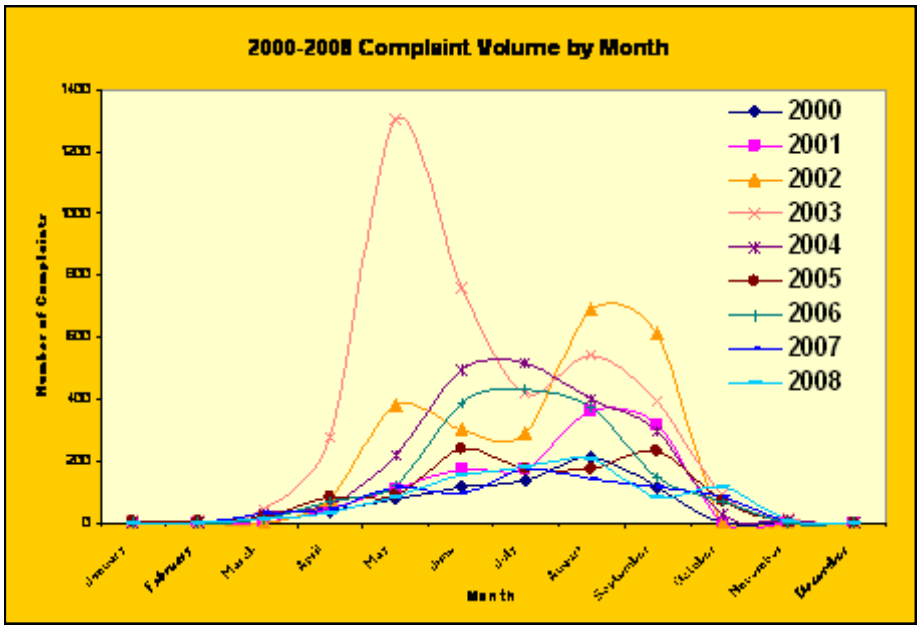


PROGRAM OPERATIONS

A total of 868 mosquito related service requests/complaints were received by Metro Call and Public Health & Wellness clerical staff in 2008. This is a slight increase (6.6%) over the same period in 2007. 2008 was very warm and dry which is similar to the previous year. The warm weather combined with drought or near drought conditions are likely responsible for the small number of service requests compared to previous years.

A normal service request /complaint response includes the investigation of the complaint site and adjacent areas. The site may include ditches, drainage easements, neighboring properties and wooded areas. Most importantly complaint investigation will include mosquito control disease prevention education. It may also include providing mosquito control treatment, issuing an order for correction and referring the site to another agency for their actions. Most referrals are sent to Metropolitan Sewer District (MSD), since they have drainage responsibilities for most of the county, but the KY Highway Department, Metro Louisville Public Works, the Louisville Metro Office of Inspections, Permits and Licenses, City of Jeffersontown Public Works, the Louisville Water Company, Jefferson County Public Schools, Metro Parks and Louisville Gas & Electric Company were also recipients of referrals.





INTEGRATED PESTICIDE MANAGEMENT PROGRAM (IPM)

The Louisville Metro Department of Public Health & Wellness Mosquito Control Program employs a broad range of treatments to mitigate mosquito breeding in different habitats. This is necessary to run a proper integrated pest management program or IPM. An IPM uses education, various chemical (pesticides), biological (natural controls) and physical control measures (change environment to eliminate habitat). Employing an IPM is an environmentally sound decision. Efforts are first made to eliminate breeding sites. When this is not feasible, then biological and mechanical controls are attempted. Selected pesticides are used when other methods are not appropriate. Pesticides are selected based on a combination of effectiveness and environmental safety. It should be noted that this is a management/control program, not an elimination program. It is designed to decrease disease vector species (i.e., mosquito populations) to healthier levels; thereby, decreasing the probability of disease transmission.

We began a new expanded approach to Mosquito Control for Metro Louisville in 2003, a multi-agency effort to reduce our mosquito population. This expanded approach included departments within the merged government and other community partnerships. During 2008, several agencies renewed their partnership agreement demonstrating their commitment to reducing the mosquito population in Louisville Metro by eliminating standing water on their property or service area, treating breeding sites or helping to educate the public. The following is a list of those agencies who committed to help the Department of Health and Wellness in our efforts to reduce mosquitoes.

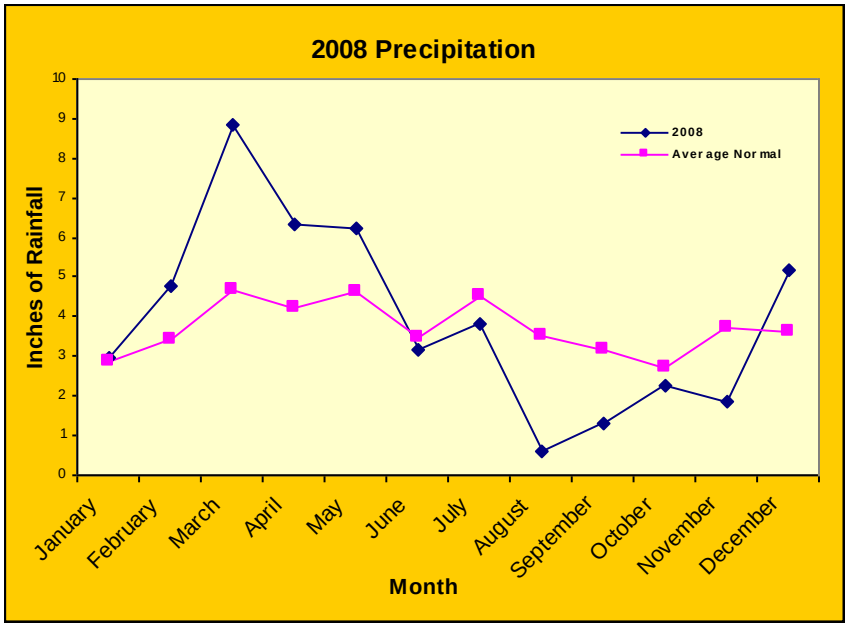
- Louisville Metro Department of Public Health & Wellness
- Inspections, Licenses & Permits (IPL)
- Jefferson County Public Schools (JCPS)
- The Louisville Zoo
- Metro Animal Services
- Louisville Gas and Electric (LG&E)/E·ON | USA
- Louisville Water Company
- Metro Parks
- Metropolitan Sewer District (MSD)
- Public Works
- Solid Waste Management and Services (SWMS)

CLIMATE

The temperatures of 2008 were somewhat normal when compared to the past few years, however the low temperatures during the middle part of the year were well above normal. The most significant aspect of 2008s climate was the rainfall. The majority of all rainfall occurred during the first five months of the year. By August, the region was experiencing another drought which led to the stagnation of numerous small streams in the area. From August to November, Metro Louisville received less than half of the rainfall expected. We see that instead of several small rain events, there is a reduced frequency in rainfall events and those few events release particularly large volumes of rain. These large events apparently occur at various times during the year but the trend toward large infrequent rain events holds true. This is of great importance to mosquito control efforts since these large rain events promote flooding and the production of mosquitoes in these flooded areas[8].

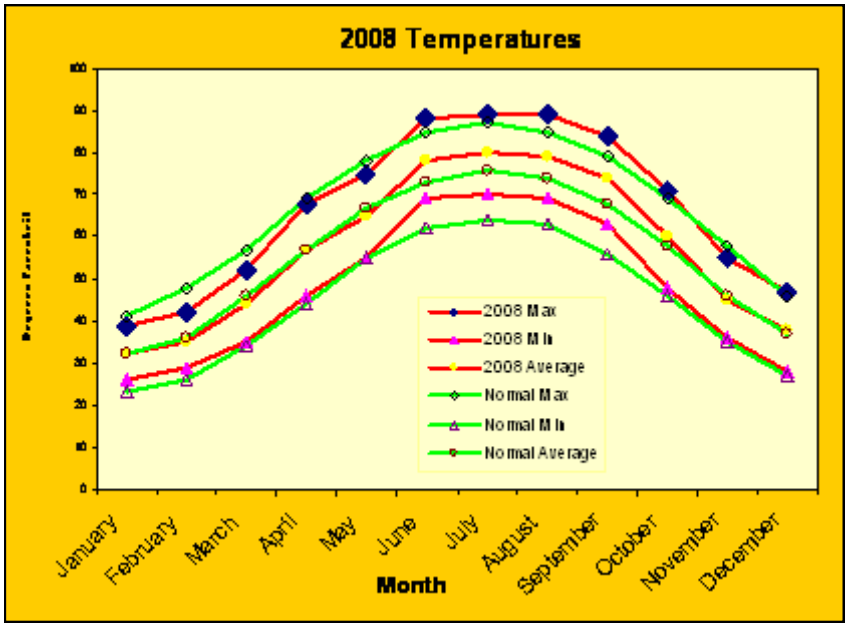
Precipitation

Precipitation for 2008 began within the normal range. Moderate rains in February and then a severe rain/snow event in March brought precipitation totals to more than 5 inches above normal for that time of the year. Above average rainfall continued through May and then abruptly changed. June and July precipitation levels returned to near normal. August precipitation accumulation was less than 1 inch (2.92 inches below normal). Below average rainfall accumulations persisted until December. Overall, 2008 was nearly 3 inches above normal, which was not particularly significant. What was significant was that almost all the rainfall for 2008 fell from January to June and July through November was drought ridden. This area of the country typically experiences no more than 2 inch precipitation extremes (the range between the low and high precipitation values). Precipitation levels in 2008 ranged from 0.62 to 8.86 inches, which is a difference of 8.24 inches. At the end of December, total precipitation accumulations were about 3 inches above normal.



Temperature

Weather in 2008 exhibited some interesting characteristics with respect to temperature. Temperatures were essentially normal for the first 5 months of the year. Though within the normal range, average highs were slightly below expected monthly temperatures. June marked the beginning of the deviation from expected normal temperatures. This was not as pronounced in 2008s monthly high temperatures as it was in the monthly lows. High temperatures averaged 3 degrees above normal, but low temperatures averaged 6 degrees above expected levels. Temperatures returned to normal in October and remained there for the remainder of the year. At year end, 2008 was 1ºF above normal.



Importance of Climate on Mosquito Season

Consistent rain events help keep streams flowing and catch basins from stagnating. Long periods of drought help reduce the number of flood water mosquitoes, but will often lead to increased numbers of container and filth breeding mosquitoes. This is generally due to the stagnation of catch basins and streams. This pattern was repeated in 2008. Complaint volume was generally the same as 2007 but surveillance trapping was increased. Mosquito numbers were up for the year.

Most of the major increases in nuisance mosquito activity appear to be linked to the stagnation of streams (which normally do not breed mosquitoes) and artificial containers. Environmentalists reported observing stagnated streams with Gambusia fish. In some cases, mosquito larvae were breeding along side the dying fish. Disease mosquito populations breeding in urban catch basin systems, were also bolstered by the lack of rain events. Heavy rains generally have a 'flushing' effect on the catch basin system, but a lack of rain concentrates organic material needed as a food source and creates a more stable breeding environment because eggs and larvae do not wash out.

Though precipitation levels are the main determinate in mosquito populations, temperature influences mosquito breeding in 2 ways: 1) length of breeding time and 2) hospitability of the natural environment. It appears that the higher temperatures may have allowed nuisance mosquitoes to hatch off of the water more quickly after heavy rain events. Disease mosquitoes breeding in catch basins did not appear to have the same effect. This could be due to catch basins being below ground where the temperature is more stable.

Overall, mosquito numbers were below normal due to reduced precipitation during a large portion of the mosquito breeding season. Temperature levels did not appear to greatly influence mosquito populations as has been seen in previous years where above average temperatures in the early spring have extended the mosquito breeding season. Above average 'minimum' temperatures for 2008 occurred in mid to late summer likely influenced human activity in the evening, prompting people to spend more time outside or with windows open. Both of these instances increase the potential for people to be bitten by mosquitoes. We see our greatest increase in mosquito numbers during the time of these warmer minimum temperatures.

2007 ARBORVIRUS SURVEILLANCE RESULTS

Grant funds have been made available from the Centers for Disease Control to the Kentucky Cabinet for Health Services for arbovirus surveillance in Kentucky for 2001 - 2008. The Louisville Metro Department of Public Health & Wellness Mosquito Control Program participated in an arbovirus work group that included representatives from the U.S. Department of Agriculture, Kentucky Department of Fish and Wildlife, Kentucky Department of Public Health, University of Kentucky Entomology Department, Kentucky State University Department of Entomology and health department staff from 17 counties in Kentucky, including Jefferson County. The Kentucky Department for Public Health (KDPH), as the lead agency for state surveillance activities, provided local health departments with laboratory testing, mosquito collection equipment, surveillance guidance and coordinating results.

Mosquitoes

Female mosquitoes require a blood meal to lay eggs[5]. *Culex* mosquitoes, the primary vector (carrier) of WNV and SLE, prefer to lay their eggs in heavily organic, stagnant water[2, 5]. Gravid traps and light traps were utilized to collect mosquitoes. A gravid trap consists of a net and a motor/fan assembly resting atop a two-gallon pan containing hay infused water. The infused water is created by adding hay and yeast to a container of water and allowed to ferment. As female mosquitoes attempt to lay their eggs, they are pulled into the net by the fan.

Gravid traps were set up weekly from mid May 2008 through early October 2008. Female mosquitoes were collected and identified by Metro Public Health Staff and then tested for the presence of West Nile Virus by

the Department of Public Health and Wellness Laboratory. Samples were pooled based on species, location and date of collection. Mosquitoes of the same species collected from a single location and date were combined for arbovirus testing. Each test sample contained as few as one mosquito and no more than 50 mosquitoes. A total of 181 mosquito samples were submitted from locations in Louisville. These sites were chosen based on historical data indicating areas with dense mosquito activity, prevalence of infected humans and/or horses and preferred habitat of the *Culex* mosquito, primary vector of WNV and SLE. These habitats include ponding water from farm runoff, sewage overflows and storm water/sewer catch basins along streets. There were seven WNV positive mosquito pools identified in 2008 which were the highest number observed since 2002.

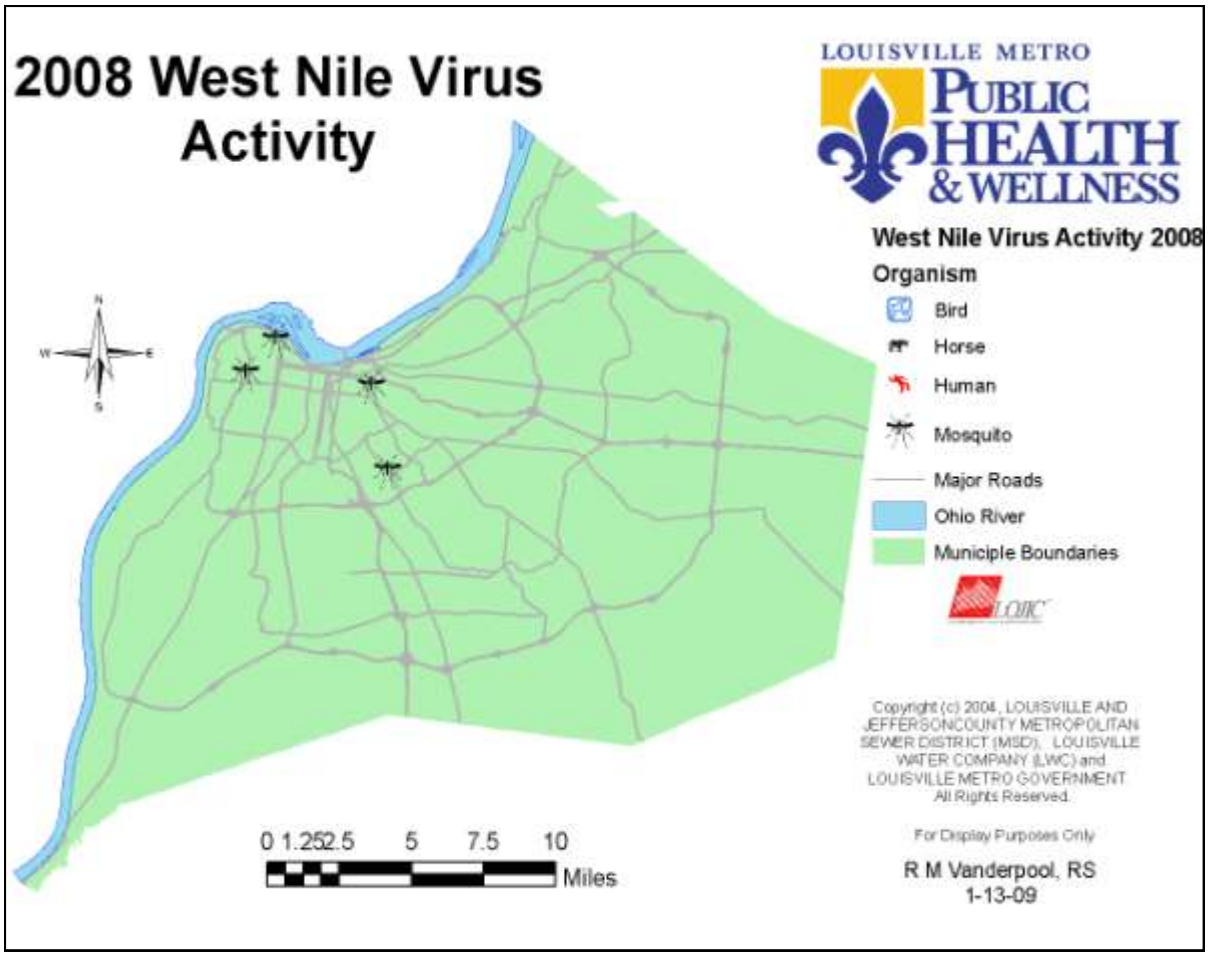
Avian

Avian morbidity/mortality surveillance appears to be the most sensitive early detection system for WNV in a community. Six dead birds found in the Louisville Metro area were submitted by the Health Department to the Metro Health Department Laboratory for WNV testing. No birds tested positive for WNV in Metro Louisville during the 2008 season. There were two WNV positive birds found in Kentucky in 2008. The type of birds that have been found to carry West Nile Virus in Metro Louisville included; sparrows, doves, robins, blue jays, American crows, house finches**,** gold finches, grackles, a titmouse, cardinals, red shouldered hawks, a goshawk, cooper's hawks, a great horned owl and a barred owl.

In the late summer months the health department discontinued the collection of dead birds. The process is very time intensive compared to the usefulness of the results. Migrating birds have a very large flight range, making it impossible to determine where a bird may have been infected. The biggest advantage to testing birds is to determine current disease transmission within a community. This criterion was met. The map below displays the locations where dead birds were collected. Community submission of birds was much lower this year than in years past.

Horses

Surveillance for WNV disease in equines is conducted because they are mostly sentinel and therefore good indicators of disease activity in a specific area and equine health is an important economic issue in Kentucky. Locating WNV positive horses also helps mosquito control staff determine possible human exposure, which in turn impacts treatment activities and increases surveillance areas. Although there were no horses from Louisville that tested positive for WNV in 2008, there were five horses that tested positive statewide. This is a significant decrease from the 2003 season when three horses from Louisville and a 102 horses in Kentucky tested positive for West Nile virus.



WNV Activity	2008	2007	2006	2005	2004	2003	2002
Horses	0	0	0	1	0	3	10
Mosquitoes	7	4	0	0	0	1	19
Birds	0	1	0	0	10	5	63
Humans	0	1	1	1	1	0	28

Humans

Cases of encephalitis are reported from physicians and local hospitals to the Louisville Metro Louisville Metro Department of Public Health and Wellness's Communicable Disease Program. During the summer of 2008, no cases of WNV were reported to the Department of Public Health and Wellness. There were an additional three confirmed human case that met the clinical definition and laboratory criteria of West Nile Virus in Kentucky. Kentucky had a total of five confirmed human cases in 2007. The Center for Disease Control determines clinical definition and laboratory criteria. Some case studies are not carried out to completion due to lack of samples.

2008 MOSQUITO POPULATION SURVEILLANCE

Sampling of mosquitoes in the larval stage is performed whenever encountered by staff during their field activities. Larval sampling is essential for effective control for several reasons. This sampling activity allows for identification of the species of mosquitoes in the county and the identification of breeding sites. Larval sampling also helps measure the effectiveness of control methods. Treatment sites are periodically sampled to determine larvicide effectiveness. During 2008, 88 larval mosquito samples were submitted to Dr. Grayson Brown, entomologist at the University of Kentucky, for species identification.

Trap Surveillance

The Louisville Metro Health Department Mosquito Control Program primarily employs two methods of adult mosquito surveillance: Light traps and gravid traps. Each trap type plays a specific role in monitoring mosquito population. Population data assists environmentalists to provide more efficient and effective mosquito treatment.

Light Traps

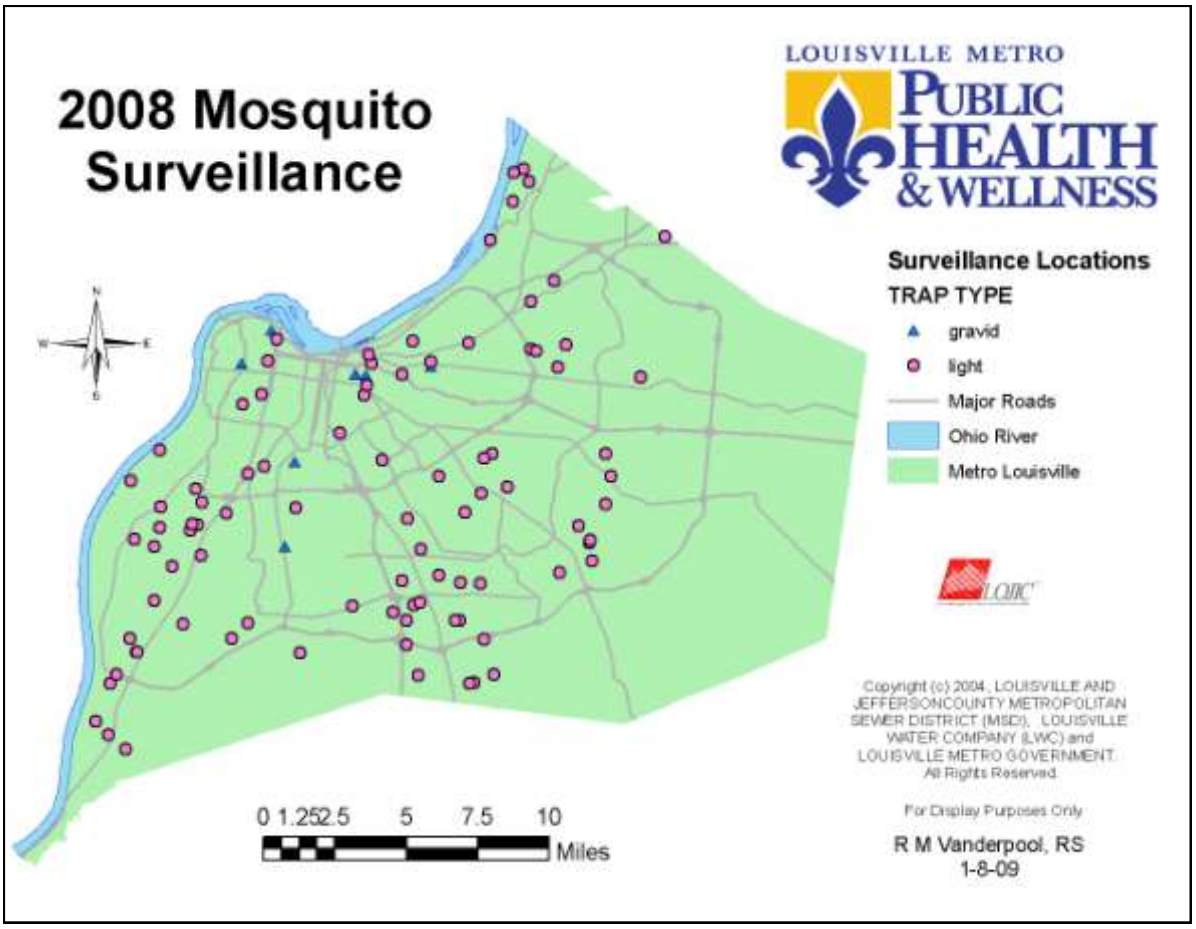
Light trap surveillance is a quantitative method of determining the number of mosquitoes in a given area. Light traps are designed with either an incandescent bulb or a black light to attract the mosquitoes. A vacuum fan is used to pull the mosquitoes from the light and blow them into a collection net. To enhance the attractiveness of the trap for mosquitoes, dry ice (solid carbon dioxide) is supplied near the light source. This double action attraction media allows for the collection both sexes of day and night biting mosquitoes. Light traps provide numbers of mosquitoes both and males. Analysis of captured mosquitoes yields both the relative abundance of disease carrying and nuisance species. Determination of numbers and species present is used as an indicator of possible problems in the area, what that problem may be (different species breed in different habitats), clues as to where the breeding site may be and whether more extensive investigation, abatement or treatment of the area is warranted. Mosquito from light trap samples are sent to Dr. Brown for identification as well.

Summer Worker Hanging Light Trap

Gravid Traps

Gravid trap surveillance can be used as both a quantitative and qualitative test for mosquito surveillance. Gravid traps by virtue of their name are more specific. Gravid refers to female mosquitoes that have taken a blood meal and are ready to lay eggs. This type of trap targets female, *Culex pipiens*, mosquitoes (locally, the primary human disease vector mosquito). The preferred breeding habitat for *Culex pipiens* is highly polluted stagnant water. The "lure" for the mosquito is a basin of water infused with rotting plant material. An apparatus employing an up-current fan is placed on the basin with the trap opening just above the surface of the water. The battery-operated trap pulls in the female mosquitoes from the surface of the water as they attempt to lay eggs and blows them into a collection net at the top of the trap. Population estimation for disease carrying mosquitoes is provided. These traps work well in artificially lit areas that would normally eclipse the lights of standard light traps. An added bonus is that gravid traps usually yield higher quality samples, though generally less numerous, which are laboratory tested for vector born disease.

Summer Worker Setting Up Gravid Trap



Trapping Frequency and Location

A regular light trap route is sampled bi-weekly with extra traps set out on an 'as needed' basis. Gravid traps are set weekly. They are the basis of our disease surveillance within the community and are evenly distributed within the urban area. Light traps samples are also often tested for the presence of mosquito borne disease. For proper disease surveillance to occur, species identification of collected mosquitoes is necessary. Sample quality and freshness of light trap samples is sometimes below laboratory standards. Yearly sampling begins in Mid-May and generally continues until late September or early October. Traps are set up early to late mid day and picked up at about the same time the following day. This is to assure that both day and evening biting mosquitoes are captured.

Mosquito trap surveillance is conducted on private residences, businesses, public areas and undeveloped land per environmentalist's discretion and/or complainant's request. These sites are usually of a random nature (not regularly sampled) and numbers are tracked separately. These numbers (relative abundance of mosquitoes) are used to validate reports of problems (citizen mosquito complaints) in the area and see to what extent the problem has progressed. Both gravid and light trap sampling numbers are a primary criteria used in adulticiding operations (fogging) in the community. This assists environmentalists in determining the best method of treatment and allows for greater equity of services across the metro area. Adulticiding criteria are discussed in greater detail in other sections of this report. Light trap sample numbers are also used to check the effectiveness adulticiding efforts as well.

During the early and late parts of the light trap season, environmentalists set, collect, and sort samples. Starting in mid May and lasting till early August, summer intern workers perform these duties. Environmentalists teach interns the methodology of surveillance, tips for successful sampling and procedures for setting up, collecting and sorting the samples. Intern work is overseen and reviewed by the environmentalists to assure quality control standards.

Interpretation of Data

During the 2008, mosquito control season, the Louisville Metro Health Department's Mosquito Control Program conducted mosquito surveillance in the community. 105 different locations were sampled for adult mosquitoes. This constituted 288 separate surveillance events. Overall surveillance activities were 20% more than the previous season. This season the Mosquito Control Program had a full number of seasonal staff, many of which had previous experience or education. This influenced the efficiency of surveillance operations, allowing more surveillance to occur.

Light Traps Data

Mosquito surveillance numbers have been low in the past several years in comparison to previous seasons. A portion of this has been a shift in focus from basic mosquito abundance to specific mosquito species abundance to determine the potential for disease. The frequency of regular light trap events has been scaled back to bi-weekly operations to accommodate this as well as the necessity for more 'whole community' surveillance. 2008 saw the highest number of mosquitoes out of the last five years (14, 206). Only 3499 mosquitoes were collected from light traps in 2007. 4048 mosquitoes were collected in 2006, compared to the 7476 in 2005 and 6857 collected in 2004.

The trap site at the Evangel Church wet woods had the highest single number of mosquitoes (i.e., 2300), caught in a 24 hour period. This site is a large pretreatment area which has recently had new wetlands installed on the northern boarder. The southern boarder is a slow moving stream with often stagnates during periods of drought. These features provide a great variety of breeding habitat and an increased potential for large mosquito populations.. This same site averaged the highest number of mosquitoes per trap of the regularly monitored locations for the season. This site is one of our large surveillance sites. It is regularly one of the top 3 mosquito producing regular sites monitored by the Department of Public Health and Wellness. The Evangel Church wet-woods had the 2nd highest surveillance counts last year. Both of these wetlands were at one time part of one larger, single wetland. They are now bisected by I-65. The highest peaks this season were seen starting in mid July and running through late August . This was the hottest, driest period of the year.

Gravid Traps Data

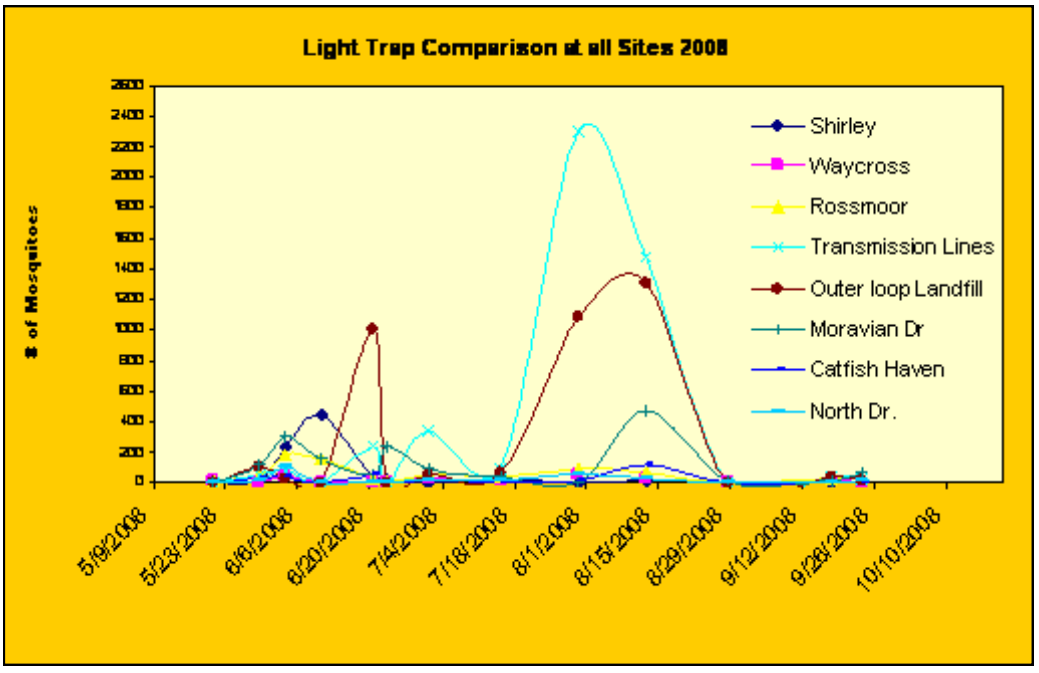
Gravid trap samples peaked during the same period as the light trap samples. One major difference exists however. Light trap numbers appear to be focused in the spring and then taper after August. Gravid samples begin to rebuild later in the season, but had modest early season numbers. The highest gravid trap collection number was 149 mosquitoes from the Hull Street sampling site. This site is consistently in the top 4 gravid surveillance sites The Hull Street site has a high density of catch basins that hold water. 2 blocks over from the trap site is a historic cemetery with is known to have catch basins and artificial containers throughout the property. High numbers at this site may be a result of improper treatment of standing water areas on the cemetery property. Management at this site has since reinstituted a treatment program The high numbers at the Hull site likely corresponded with the lapse of treatment of the catch basins on the cemetery property. A small pond at the rear of the cemetery, which normally drains out had become stagnant and that is another potential source.

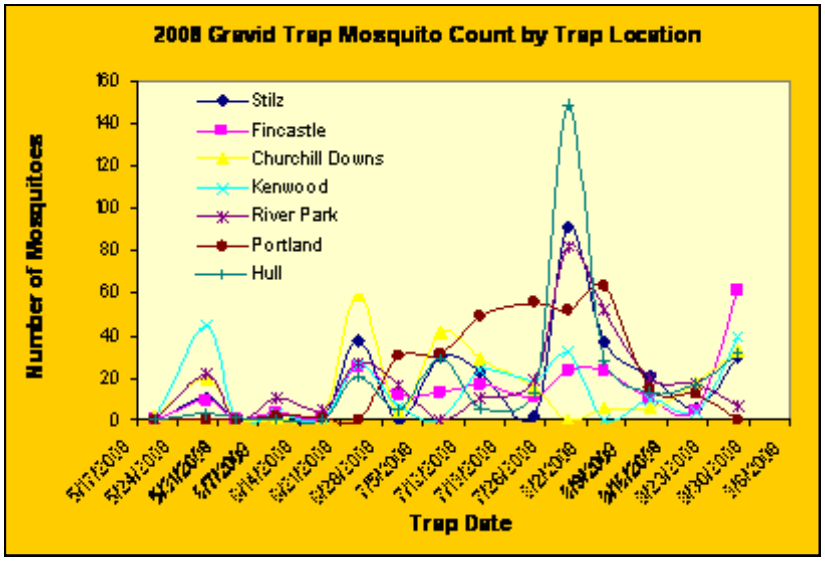
Trends in Surveillance Data

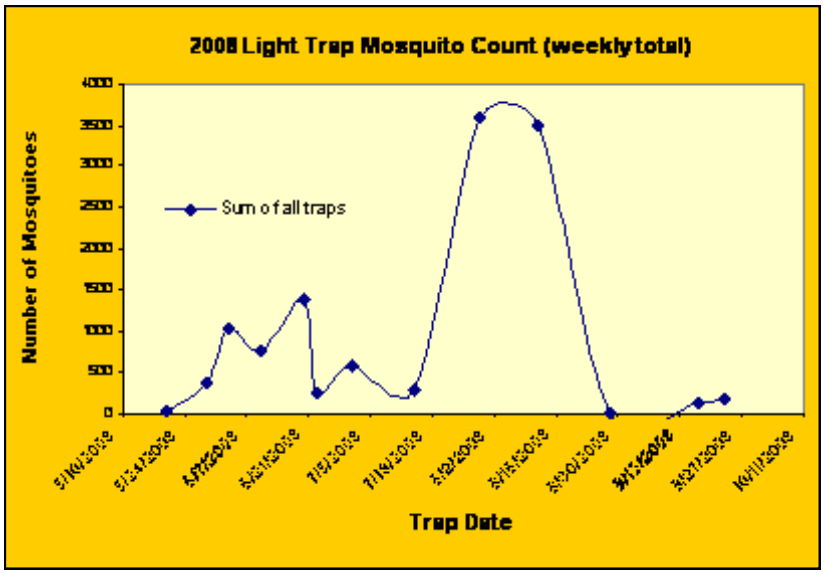
Typically, much of the difference between the light trap and gravid trap data can be related to the species of mosquitoes that each trap attracts and the primary breeding habitat of those mosquitoes. For example, flood-water-breeding species such as *Aedes vexans* are very receptive to light traps, where as *Aedes albopictus* (a container breeder) is not readily attracted to light. This is only one of many potential examples that likely impact the difference in gravid trap sampling numbers and light trap sampling numbers. An interesting aspect of the results of the gravid traps and the light traps the past few years has been a trend where a greater total percentage of mosquitoes are caught early in the mosquito season with the light traps and later in the season for the gravid traps; however, this trend, though not true for 2007, was repeated in 2008. Although both the light traps and gravid traps recorded their highest numbers in late July, gravid trap collections still tended to increase until the end of the mosquito season. Light trap numbers increase from early spring, peaking in late July and the reaching season lows at the end of the season.

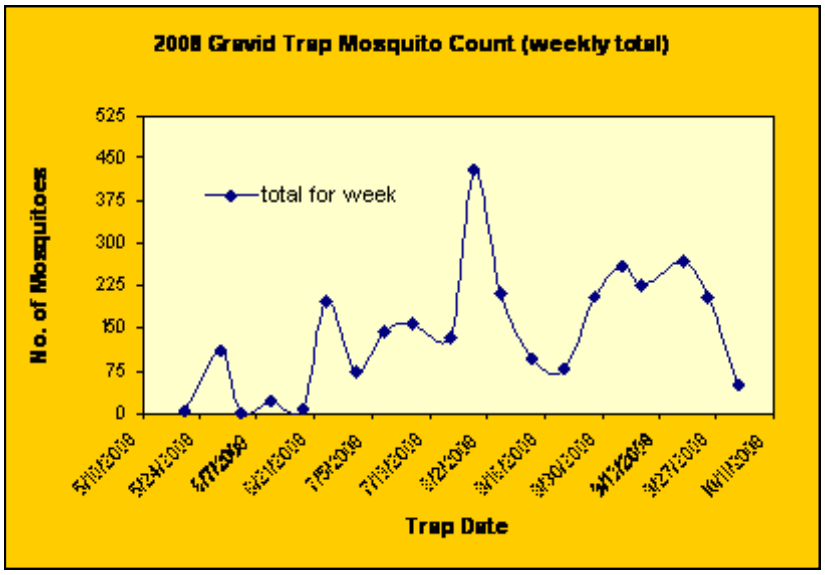
Typical observations are most likely related to the prevailing climate at that time of year and the mosquitoes that are best suited for that climate. More rainfall and lower temperatures in the early summer will favor certain species of mosquitoes whereas dryer weather and hotter temperatures favor other mosquito species. This historic information could prove to be very useful when planning mosquito treatment in the community; however, the 2007 information shows how changes in climatic conditions can alter mosquito abundance during a summer. Although control efforts might be able to target specific breeding habitats and species of mosquitoes based on historic data, a mosquito control programs should remain versatile and ready for variations in climate conditions despite these past trends.

Below are the adult mosquito population comparisons for 2008, collected from light traps and gravid traps. The number of mosquitoes collected at individual sample sites varied from week to week. Several factors can influence sample collection, including weather conditions, trap functionality and general location. For example, mosquitoes are not mobile during rain or heavy winds. Large numbers of mosquitoes can also hatch off 7-days after heavy rainfalls, especially after floods. Additionally, when the light in a light trap malfunctions, a significantly reduced number of mosquitoes will be collected.




2008 Gravid Trap Mosquito Count by Trap Location
Number of Mosquitoes
Trap Date
Stilz
Fincastle
Churchill Downs
Kenwood
River Park
Portland
Hull


2008 Light Trap Mosquito Count (weekly total)
Number of Mosquitoes
Trap Date
Sum of all traps


2008 Gravid Trap Mosquito Count (weekly total)
No. of Mosquitoes
Trap Date
total for week

NUISANCE MOSQUITOES

Aedes albopictus, most commonly known as the Asian "tiger" mosquito, is an emerging problem in the realm of modern mosquito control in Metro Louisville. It has virtually replaced the Yellow Fever mosquito (*Aedes aegypti*) as the major domestic nuisance biter in the United States[4, 6]. The 'tiger' is almost exclusively linked to human activity. They are "opportunistic feeders", biting equally as persistent and vicious in broad daylight and at dusk (dawn hours as well)[1]. Their flight range is generally short, remaining close to their breeding site. Many *Aedes albopictus* travel less than 100 yards in a lifetime.

Aedes albopictus-"Asian Tiger Mosquito"

Their typical host seeking behavior involves approaching at ankle level and working its way up the body to find a suitable spot to bite. Unlike most mosquitoes, *Aedes albopictus* (also *Culex pipiens*) has been known to enter homes and bite individuals during normal sleeping hours. The Asian tiger mosquito grows no longer than a 1/4 of an inch. Its markings are unmistakable, even by the amateur observer. The tiger's predominant color is black, but is highlighted by snow-white bands around its hind legs.

Aedes albopictus is native to Asia and fairly common in the oriental region. In August of 1985, it was detected just outside Houston, Texas in substantial breeding populations. Since then it has rapidly spread throughout the southeastern United States, the eastern seaboard, and into parts of the mid west. In its early dispersal period, the mosquito appeared to be connected to the interstate highway system. This proposed relationship between dispersal and major transportation routes would be expected from a species transported largely by human activities such as the commercial movement of the scrap tires for retreading and recycling. Waste tires from Asia are considered the most likely source of the Texas infestation. Transportation of those tires from Texas to other tire recapping/recycling hubs within the United States led to their rapid dissemination[6].

The Asian "tiger" mosquito apparently originated as a forest species that deposited its eggs in tree holes[4]. Over time, this mosquito has become almost totally dependent on human kind for artificial containers. They favor waste tires but will thrive equally well in flowerpots, tin cans, buckets, cemetery urns and any other object that will hold water long enough for the mosquito's life cycle to be completed. In Metro Louisville,

this species has been discovered in a catch basin surveillance sample, which has not previously been documented. In Bernheim Forest, adult Asian Tiger mosquitoes have been observed emerging from on site catch basins. This is considerably concerning since it shows that these mosquitoes may be invading yet another niche, which is particularly abundant in both urban and rural areas.

Aedes albopictus is not simply a nuisance due to its viscous biting, but is also considered a potential for vector disease. The Asian "tiger" mosquito is a maintenance (occasionally epidemic) vector for Dengue Fever. This disease is mostly seen in tropical areas, but has been a sporadic health problem in the southern U.S. and is relatively common in the Caribbean. Carriers of the virus could easily introduce it to new areas by regional travel. Laboratory tests show that *Aedes albopictus* is a competent vector for some 22 arboviruses but only Eastern Equine Encephalitis and Cache Valley have been isolated from United States populations.

The only feasible way to reduce the numbers of these mosquitoes is to limit their habitat. This is accomplished by tire amnesty days, educational flyers, information presented upon inspection, and cleanup orders. Unfortunately this only limits a small amount of the breeding population due to the fact that artificial containers can be found anywhere, ranging from well-kept properties to junkyards.

Ochlerotatus japonicus japonicus (Theobald) is another introduced mosquito species in the Metro area[7]. This mosquito was first observed in Kentucky in 2003 in the central and northern parts of the state. This species was first observed in the United States in 1998 in New York (Suffolk County) and New Jersey (Orange County). It has since spread to 11 other states. 2004 was the first year that *Oc. japonicus* was observed in Jefferson County. The species was again observed in both 2005 and 2007. This species is more tolerant of cold temperatures than *Aedes albopictus*; therefore, it too could become established in this area.

As its scientific name implies, *Oc. japonicus* is native to eastern and south eastern Asia[7]. This mosquito is closely related to *Aedes albopictus* and *Oc. triseriatus* a native mosquito species. It also shares many of the same characteristics of these two species, particularly, the ability to breed in small containers such as tree-holes, tires, and miscellaneous small collections of water. Because this species is so new to the United States, the body of research written in English is somewhat sparse. Most of the research comes from Japan, China and Taiwan[7]. *Oc. japonicus* appears to travel about 600' from its breeding site. It is a black to dark brown mosquito with conspicuously yellow longitudinal strip down its thorax. Because of its other thorax markings it can be misidentified as *Ae. aegypti* (the yellow fever mosquito).

This mosquito is of particular importance because it is a potential disease vector in the Louisville Metro Area. *Oc. japonicus* has been shown as an efficient vector of the West Nile Virus but does not exhibit the same aggressive 'human-biting' behavior that *Ae. albopictus* does. At this time however it is unknown how the presence of this mosquito will influence natural human transmission of WNV. This species will be monitored closely in the seasons to come, to better quantify its establishment and what future research reveals.

TREATRMENT PROGRAM

The Mosquito Control personnel use two major treatment regimes:

1)Larviciding is the treatment of known breeding habitats of mosquitoes or areas of standing water. Water is the only habitat where mosquito populations can grow. Treatment of these areas will reduce mosquito populations before they can reach adulthood and begin biting people.

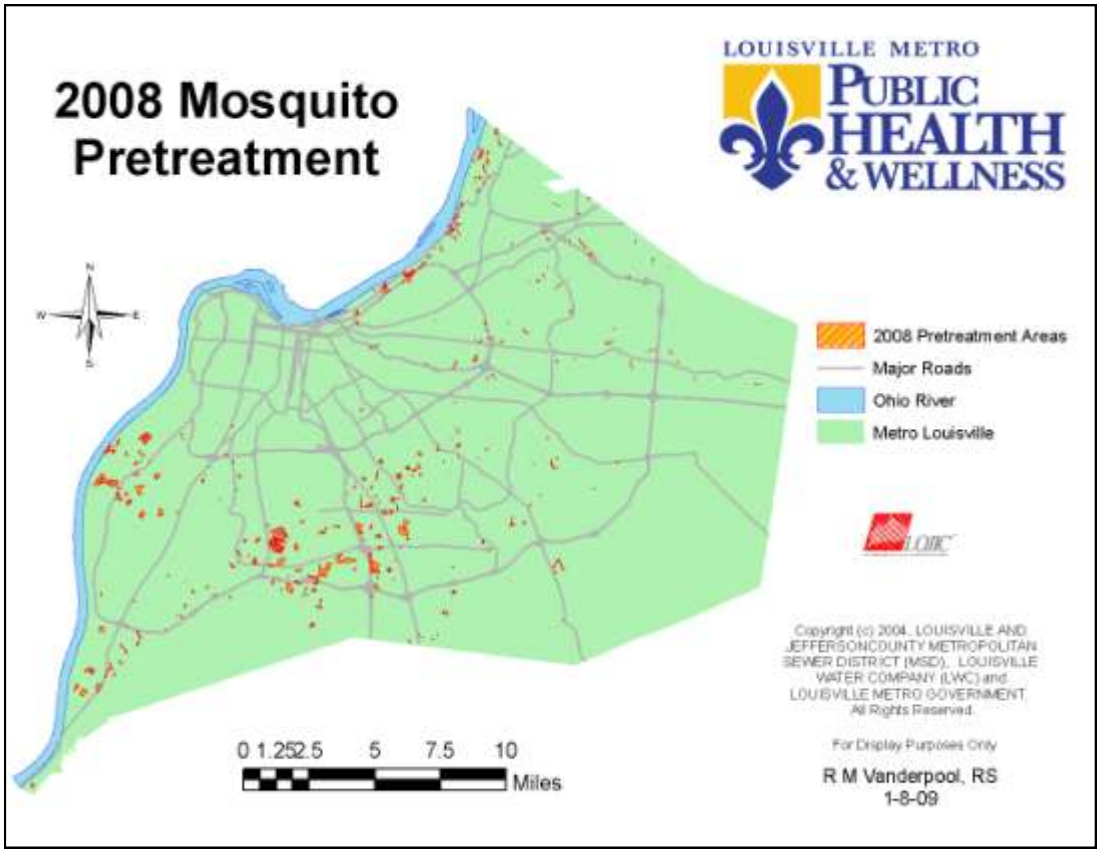
2) Adulticiding (treatment of the adult stage of the life-cycle) will reduce the biting population of mosquitoes and a marked reduction in mosquitoes will be seen for a few days to a week. The main problem is that unless the breeding site is treated or eliminated a new hatch-off of mosquitoes will occur within a few days after the

biting population is replenished. This is the reason why larviciding is a more effective means of control than adulticiding and why the department directs substantially more effort towards larviciding.

Larvicide Application

Larviciding activities are preformed throughout the mosquito-breeding season, but most extensively in the spring when large areas of the county have standing water. Effective pretreatment of these areas will reduce the summer mosquito population. From a list of known mosquito-breeding sites, referred to as route stops or pre-treatment areas, program staff can direct their work. This list is updated yearly, with new sites added along with remediated sites being removed from the list. These sites are primarily public property, right of ways, drainage easements and vacated private property, nearly 300 of which are monitored and treated on a regular basis throughout the mosquito breeding months. Larviciding is performed using liquids for immediate control, and granular/briquette formulations for sustained residual effect. Wet woods and swampy areas are the priority in the early spring, since as vegetation increases in late spring/early summer these areas are virtually inaccessible. Through surveillance methods the effectiveness of the activities and the need for further treatment can be determined. For example, because of extensive rains late in the 2006 season, many pretreatment areas that should have been dry were flooded much like they are during the spring. This resulted in additional pretreatment larviciding activities.

Larviciding activities are done on an as needed basis (other than pretreatment). When inspections are performed the area is assessed for active mosquito breeding or potential mosquito breeding. If water will stand long enough to become a breeding site (5-7 days) or an area that frequently floods, the area will be treated. Dependant on the problem area, different larvicides are chosen to best control mosquitoes in both an efficient and cost effective manner.



Larvicide Products

Agnique® MMF is a biodegradable, alcohol ethoxylated surfactant, made from renewable plant oils. Agnique® MMF can be applied to any mosquito habitat with standing water. Using conventional spraying methods, an invisible monomolecular film rapidly spreads over the surface of standing water habitats. This film interrupts the critical air/water interface in the mosquito's larval and pupae development cycle causing them to drown.

Altosid/ Altosid XR/Altosid pellet® are chemical products made of methoprene an insect growth regulator hormone. It effectively changes the life cycle of the mosquito such that it cannot hatch out from its aquatic form, thus it never matures into a biting adult. This product is virtually non-toxic to fish, mammals and non-dipterans (insects other than flies). It can be used in numerous environments because of its low toxicity. Our program uses different formulations of this treatment to achieve our goals of decreased mosquito breeding. The regular formulation has a residual of up to 30 days. The XR formulation has a residual of up to 150 days. The XRG formulation is granular designed to treat shallow or intermediate areas of standing water for 21 days.

5% Skeeter Abate is an organophosphate pesticide which affects the nervous system of the mosquito larvae, there-by killing it. The main use of this product is the treatment of tires and tire piles. It is also used in highly organic habitats such as cesspools, septic overflows and other similar impoundments. This product has a residual of up to 30 days.

Vectolex CG/Vectolex WSP are biological treatments. The product is a corncob granule infused with the bacteria *Bacillus sphaericus,* which dissolves into the water on contact. Bacteria infect the gut linings of the mosquito larva, eventually killing it. This product has a month long residual and is only toxic to other aquatic flies (black flies, midges, punkies).

Golden Bear is a petroleum distillate similar to naphtha (lighter fluid). It is mixed with a surfactant (detergent spreading agent). The product spreads evenly over the surface of the water, suffocating the mosquito larvae and pupae (larvae and pupae breath air). This and Agnique are the only product we use that are effective in killing pupae.

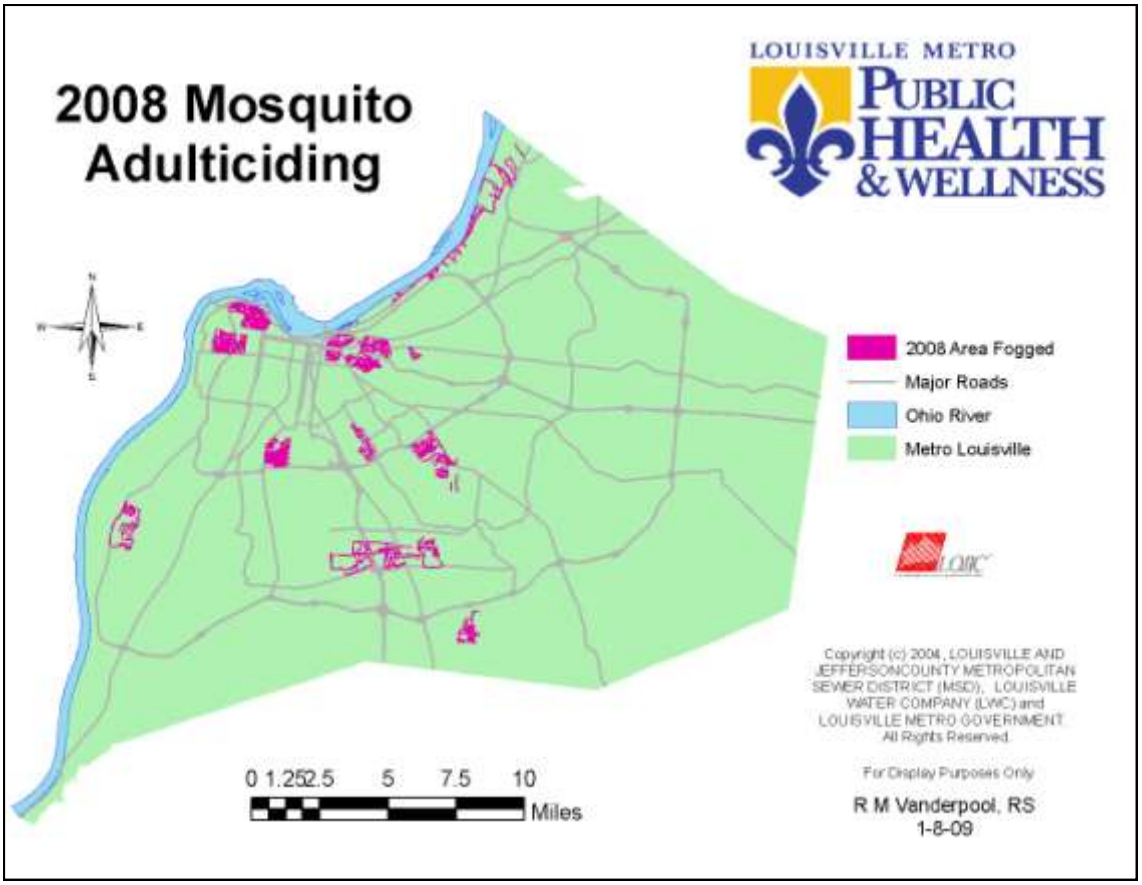
Adulticide Application

Adulticiding is done when specific criteria are met. The criteria are based on surveillance done in the area prior to adulticiding activities. This consists of overnight light trap collections of 100+ mosquitoes, gravid trap collections of 50+ mosquitoes, a substantial number of mosquitoes swarming and landing on humans per minute (observed by program staff), the number of local complaints and/or the presence of vector borne disease in the area (mosquito surveillance, human surveillance, and horse surveillance).

Bird surveillance was not used as primary criteria because they are highly mobile and not good indicators of specific target areas. Bird data, due to their mobility, is assessed regionally. The extent of the treatment area was based on the average flight distance of the Culex mosquito (vector for West Nile Virus and St. Louis Encephalitis). The average flight distance is 0.5 mile.

Treatment areas were set as a 1mile radius with the positive sample or trap site as the center. Once an area had been selected for adulticiding, hourly weather forecasts were checked for the proper conditions so that adulticide would effectively kill mosquitoes, which includes wind speeds under 10 mph, no precipitation, and ambient temperatures less than 85^{o} F.

Included is a map indicating the areas within the Metro Louisville where mosquito adulticiding activities



PESTICIDE USAGE: The Mosquito Control staff applied the following pesticides:

Pesticide	2008	2007	2006	2005	2004	2003	2002
Abate 5% *lbs*	73	260	239	477	860	1,210	625
Vectolex CG *lbs*	89	33	106	199	190	494	46
Vectolex WSP *packs*	181	177	1,059	320	2,085	618	2,440
Altosid *briquettes*	12,339	11,536	13,054	5,676	22,190	16,565	11,642
Altosid XR *briquettes*	7,176	6,344	4,184	7,828	5,940	5,610	1,823
Vectobac *gal*	0	0	0	0	0	10	2
Golden Bear *gal*	0	0.25	1.43	13.8	5	18	5
Anvil 2+2 *gal*	100	106	93	151	358	15	0
Biomist 4+4	0	70	144	0	0	0	0
Agnique	32	8.76	3.4	0	0	0	0
Biomist 3+15	0	0	0	0	0	210	66

were conducted, representing 6811 acres and 28 hours of adulticiding.

METRO AGENCY PARTICIPATION
Some examples of how these agencies worked toward eliminating mosquito-breeding sites in addition to applying larvicides:

IPL: Issued orders for correction of standing water to property owners
Fire & Rescue: Provided mosquito-trapping locations
Louisville Zoo: Monitoring Resident animal population for disease presence.
Metro Solid Waste: Pick up unused tires and drill holes in recycling bins.
Metro Parks: Detailed report listed in Addendum B
Public Works: Detailed report listed in Addendum C

DRAINAGE BOND INSPECTION PROCESS
Louisville and Metro Louisville Health Department Mosquito Personnel participate in the multi-agency subdivision bond release process. All new residential and commercial developers are required by the Department of Public Works to post a performance bond for each new proposed development to ensure all proposed road, drainage structures and easements are properly installed. Retention and detention basins are two types of drainage structures that may create mosquito-breeding sites if not properly constructed. Several agencies, including MSD and the Health Department will conduct an inspection, issue a list of needed corrections and subsequently either release the bond back to the developers or retain the funds to perform needed drainage improvements. This ensures that positive drainage is established at the time the developer is released from responsibility and the maintenance of the development is turned over to MSD and/or the new property owners. This allows environmentalists to find potential breeding sites before the subdivision is finished and have the problem sites corrected. This reduces the amount of drainage related breeding sites in residential neighborhoods and thereby reduces mosquito populations in a long-term manner. Several inspections are usually conducted before the developer's subdivision bond is released. Drainage and Street Closure inspections are conducted throughout the year.

Other Abatement Procedures
When possible, small impoundments in streams and ditches are cleared to restore proper flow, since most mosquitoes do not effectively breed in running water. When this cannot be done, these areas are referred to the Metropolitan Sewer District (MSD), for abatement.

Areas of standing water on private property fall under enforceable ordinances within the county structure. Dependent on the problem at hand, owners of the property may be ordered to properly drain and grade the property or to purchase appropriate chemicals and treat the standing water until the end of the mosquito-breeding season.

Gambusia, a small native fish genus, is found in most creeks and permanently wet ditches in Metro Louisville. These fish are voracious eaters of mosquito larvae and pupae. They are transplanted into other creeks, decommissioned waste water treatment plants, ponds, lakes, water retention areas, untreated swimming pools, and ditches where mosquito breeding is found and water will be present year-round to ensure fish populations will be sustained. The Louisville Metro Louisville Metro Health Department Mosquito Control Program obtains a permit from the Kentucky Fish and Wildlife Department to collect and transplant these fish in Metro Louisville.

Mosquito Control Catch Basin Treatment Agreement

Within the MSD combined sewer system there have been 14,500 catch basins identified that by design hold water to prevent sewer odors from chimneying from the sewer system. These catch basins hold water through out the year and provide excellent breeding habitat for disease vector mosquitoes.

In an effort to prevent the breeding of mosquitoes in these basins the Mosquito Control Program hires seasonal workers and assigns to them the duty of monthly treatment of each identified basin. Assigned staff uses special purpose, right hand drive, vehicles which allow the staff to position themselves directly over the basin, confirm the need for treatment and apply larvicide briquettes. The Department of Health and Wellness has a cost recovery agreement with the Metropolitan Sewer District that covers the cost of basin larviciding. This season, the treatment cycles began the last week of May and continued through September.

During the 2008 mosquito season the catch basins in the combined sewer system were treated at least three times. A total of 58,736 catch basin larvicide applications were made during the 2008 Mosquito season.

PUBLIC EDUCATION

Public education is an integral part of the mosquito control program. The principal vector of West Nile Virus and St. Louis encephalitis in Metro Louisville is *Culex pipiens*, the house mosquito. It is highly domestic and breeds in artificial containers such as waste tires, buckets, pet watering bowls, wading pools, clogged roof gutters and tin cans that can be found yards. It is very important for the public to understand how and where mosquito breeding takes place and how it can be properly eliminated. Since it is impossible for mosquito control staff to conduct wide area surveying, the program has created several pamphlets with the help of the environmental educators to distribute to the public.

Several pamphlets have been created in response to the public's continued request for information. Specifically there is "West Nile Virus, some answers for you", "STOP Raising Mosquitoes in Your Yard & Home", "Mosquitoes Buggin' You? If you're breeding them…your feeding them." And "Asian Tiger Mosquitoes, The Daytime People Eater." New educational materials were created in 2004 and distributed in person, by mail, Internet and at local home, garden and hardware stores. The new pamphlets included information for the homeowner on how to properly eliminate standing water on their property and how to properly treat mosquito-breeding sites. These pamphlets also described the various types of larvicides available to the homeowner and where to purchase them. Because of the popularity of these pamphlets and their all-inclusive information about mosquito abatement for the homeowner they were used in the 2008 mosquito season with only minor modifications. Most of these pamphlets are also available on line at: http://www.louisvilleky.gov/Health/Printer+Friendly+Materials.htm.

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Heath Department Staff regularly attended and presented programs at public meetings and events such as; Earth Day at the Louisville Zoo, lawn and garden shows, neighborhood association meetings, Metro Council meetings, and KY State Fair exhibit area. Various agencies assisted the Department of Health and Wellness with distributing this educational material to residents. Environmental Health Educators regularly discuss mosquito biology and control during presentations for schools.

Health and Wellness staff also presented mosquito control information during television, radio and newspaper events as well as community/neighborhood presentations.

Health and Wellness staff advises the public on proper application of insect repellants and how to dress to reduce mosquito bites. Residents are encouraged to repair window and door screens and eliminate any openings a mosquito could enter a house.

The public is provided information on other pest problems including bed bugs, ticks, mites, fleas, spiders, bees and wasps. An attempt is made to identify many insects brought into the office, provide information on the insect's life cycle and make suggestions for control.

SUMMARY

The 2008 Mosquito Control Season was another active West Nile Virus season for the Louisville Metro and the surrounding areas. Mosquito Control surveillance discovered seven positive West Nile mosquito pools in Jefferson County and a total of 12 positive pools were found throughout the state. The seven positive mosquito pools found in 2008 was the highest total observed during a single season since 2002. Six avian samples were brought to the Department of Public Health and Wellness , but none tested positive for West Nile virus. There were three confirmed Human case of West Nile Virus in the state of Kentucky, but no confirmed human case were reported locally to the Department of Public Health and Wellness.

Drought conditions were experienced throughout much of the summer of 2008. A total of 864 mosquito related service requests/complaints were received by Metro Call and Health Department clerical staff in 2008. This was a slight increase over the same period in 2007. The similar weather conditions for both 2007 and 2008 are likely the reason for the similar number of service requests.

Health and Wellness collected mosquitoes from 105 different locations in Metro Louisville for a total of 288 surveillance trap collections. Fogging operations were employed to reduce both nuisance mosquito populations as well as those mosquito populations that were potentially disease carrying. Our continuance of a targeted approach to adulticiding appears to be effective in reducing mosquito numbers in problem areas as well as limiting the community's potential exposure to pesticides.

Metro Louisville continued to see county wide complaints dealing with Asian Tiger Mosquitoes. These mosquitoes do not fly great distances and their ability to breed in nearly any small accumulation of water allows them to inundate large sections of neighborhoods and cause problems. The impossibility of finding all these tiny water accumulations continues to frustrate complaint resolution and mosquito reduction measures.

***Program Achievements*:**

- Through our mosquito surveillance program, seven mosquito pools were identified as being positive for West Nile Virus. This was the most positive mosquito pools found since 2002. Mosquito reduction activities targeted these positive West Nile locations.

- Six birds were submitted to the Health Department laboratory for West Nile virus testing. None tested positive for West Nile Virus.

- During the summer of 2008, a total of 868 mosquito related service requests/complaints were received by Metro Call and Health Department clerical staff.

- Mosquito control staff completed fogging/adulticiding for the Metro area which translates in 6811Acres or 28 hours of adulticiding

- 58,736 catchbasin larvicide applications were made during the 2008.

- The Mosquito Control program continued its mosquito partnership agreements with other partner agencies that assist us by maintaining properties, eliminating mosquito-breeding sites, and/or to treat standing water. The partnership allowed us to improve communications with several partners in 2008. As a result, we were better able to coordinate mosquito control activities with these groups.

- GPS units were employed to track catchbasin treatments and fogging operations. The data collected from these units has been used to more accurately show where treatment operations have occurred.

- We continued to use the dial-logic system to call citizens living in an area scheduled to be fogged. To improve notification we waited to fog these areas at least 24 hours after the first dial logic calls were made. We posted all fogging information on both our hotline and web site to give up-to-date fogging information. We also posted signs in areas where fogging were scheduled when possible.

- We have now retro-fitted both of foggers with the SmartFlow flow control system. The SmartFlow system has provided us a greater level of accuracy and precision by keeping track of time the fogger is on, miles driven, and adjusting flow with change in vehicle speed. It automatically calculates the amount of pesticide applied per acre.

- We have moved away from any and all adulticiding pesticide containing permethrins and will continue our efforts to purchase the most ecologically and biologically safe pesticide products available. Mosquito fish (*Gambusia affinis*) as an alternative to pesticides was used in long standing breeding sites such as derelict swimming pools.

***Funding requests*:**

- The department has a need to replace a few aging computers. Many of our computers have broken down or have become functionally obsolete. Program staff must use computers in the field to retrieve and update complaint information.

Staff Training

- The mosquito control staff attended a mosquito control workshops offered by Clark Mosquito Control on February 27, 2008 in Louisville, Kentucky.

- All mosquito control staff attended a pesticide training offered by ADAPCO on April 9, 2008 in Louisville, Kentucky.

- Seasonal workers and program staff attended a two day Mosquito Identification Training at the University of Kentucky in Lexington, Kentucky. The class provided all workers with basic mosquito identification skills. The class was taught by Dr. Grayson Brown at the University Of Kentucky Department Of Entomology.

- The supervisor of the program attended the Environmental Public Health Leadership Initiative offered by the Centers for Disease Control and St. Louis University. This is a year long leadership training with the graduation scheduled for February 2009.

- One mosquito control staff member completed a Masters of Science degree in Biology, the associated research and thesis focused on environmental factors influencing mosquito presence.

- One mosquito control staff member attended 2 Esri-ArcGIS training classes sponsored by the Metropolitan Sewer District.

Educational Issues

- In October 2008, an environmentalist gave a public health presentation focusing on mosquitoes to Medical Geography students at the University of Louisville.

- We assisted a two group of nursing students from Bellarmine University who were completing a semester long project related to mosquito control and pesticide management.

***Programmatic issues*:**

- We are still examining the practicality of moving toward the use of alternate adulticiding pesticides. We believe these products help with our efforts to purchase the most ecologically and biologically safe pesticide products available.

- We want to continue to improve communication with all of our mosquito control partners in order to enhance our integrated pest management system. By focusing improvement with these relationships we hope to avoid any potential duplication of service, ensure that all standing water is either eliminated or treated, and provide assistance to ensure our partners receive the necessary mosquito control education.

Reference

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Attachment A

2008 Entomologist Report

REPORT OF THE CONSULTING ENTOMOLOGISTS FOR THE YEAR 2008

Submitted by:

Prof. Grayson C. Brown
Public Health Entomology Laboratory
Department of Entomology
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REPORT OF THE CONSULTING ENTOMOLOGISTS FOR THE YEAR 2008

INTRODUCTION

The 2008 mosquito season was our fifth year in service as consultants to the Louisville Metro Mosquito Control Project. Our main mission is to identify both adult and larval mosquitoes of concern to the Health Department, especially those known to harbor and transmit diseases to humans. Of these, the main concerns are West Nile virus (WNv) and St. Louis encephalitis. There were 3 human cases of WNv meningitis/ encephalitis fevers reported to the Centers of Disease Control for Kentucky in 2008, but none of them were fatal. These cases were reported from Kenton (2), McCracken (1) counties. This is about the same as in previous years; 2007 (4 cases statewide), 2006 (6 cases statewide), 2005 (5 cases statewide) and 2004 (7 cases statewide). In addition, a total of 2 dead birds tested positive for WNv and they were both from Fayette (2 birds) county. Of the counties submitting mosquito pools, only Fayette County (two positive pools), Jefferson County (seven positive pools), and Boone County (three positive pools) had positive results. This is a slight increase from the previous year when only one positive pool was found for the entire state. There were no other human cases, positive mosquito pools, or positive bird/veterinary cases reported for the other important mosquito-borne viruses in Kentucky for 2008 (i.e. St. Louis Encephalitis, Eastern Equine Encephalitis, or LaCrosse Encephalitis). [Source: USGS Disease Maps for 2008: http://diseasemaps.usgs.gov/index.html).

The previous four years (2004, 2005, 2006, and 2007) had shown extremes in population numbers with 2004 representing the large end of the spectrum and 2007 representing the lower end and 2005 and 2006 intermediate between the two. On the other hand, the populations of 2008 were about average for Kentucky. This probably reflects that we had about average precipitation unlike the severe drought year of 2007 (cf. below in "Weather Activity"). More details on the mosquitoes received follow:

MOSQUITO LARVAE

The larval specimens received and identified in 2008 are shown in Table 1 and are compared to the data collected from 2006, 2005, and 2004. In 2008 there were 2972 immatures submitted, comprising 13 mosquito species. Most of these species are collected regularly in Kentucky, especially in urban and suburban environments. However, four of them (*An. barberi*, *Culiseta inornata*, *Ochlerotatus canadensis*, and *Toxorhynchites rutilis*) had not been recorded in larval samples from Louisville in the previous 4 years. The two most numerous of these four, *Cs. inornata* and *Oc. canadensis*, were all collected over a 6-day time interval of April 16 – April 22 (but in different locations). These two species are known to be early season species.

The total larvae are over 10 times as many as we received last year and more than the previous four years combined. Although we saw many more specimens in

2008, the species diversity was fairly normal when compared to previous years with substantial larval numbers. For example, in 2006, we had 469 specimens distributed over 14 species, and in 2004 (another especially large larval count year), we recorded 1,133 specimens over 16 species (cf. Table 1). I reported on the link between low populations and low species diversity in my 2007 Annual Report.

When comparing the 2008 larval counts with other comparable years, especially 2006 and 2004, the main difference appears to be a large surge in *Culex* spp. numbers in 2008 compared to previous years. The numbers of the species in other genera appear to be little changed from previous years. The collection data suggest that the large surge in *Culex* was simply the result of the sampler chancing upon unusually heavy infestations. For example, of the 43 samples containing *Culex restuans*, about a quarter of the 1,000 or so specimens collected for the entire year came from only two of these samples – a sample from 306 Chippendale Ct collected 121 specimens on May 5 while another sample, this one from the transmission lines and taken on May 29, collected 103.
As in 2007, we did not find *Cx. nigripalpus* in our larval samples, even though they were present in very significant numbers in the adult samples (cf. below).

We had no larvae lost this year due to damage in shipment and, for that, we thank the our Louisville colleagues on their improved shipping methods.

ADULT SAMPLES

We received 117 samples containing adult mosquitoes from Louisville during 2008. These samples came from 65 different sampling locations in Jefferson County. The samples covered a period of 17 weeks from May 23, 2008 to October 2, 2008. This number of samples and the sample interval are both consistent with that of previous years.

Together, the 117 samples produced 11,455 adult mosquitoes for an average of 98 mosquitoes/sample. A total of 26 different species were obtained in 2008. Of the 11,455 specimens submitted, a total of 1,962, or 17.1%, could not be identified mainly because they were males (mosquito male keys are notoriously inaccurate and males are not used in any decision making regarding mosquito management). These numbers are in line with previous years.

The total adult female mosquito sample results for each species over the entire year are shown in Table 2 and compared with the previous four years (2004 – 2007). They are ranked from the most numerous species in 2007 (*Aedes vexans*) to the least numerous. Approximately 68% were *Ae. vexans* and this species typically dominates the species count. There were 26 species identified from 8 genera. There were no new state records among these species or genera. The one species that was new, *Ps. horrida*, was found in other locations throughout the state in each of the preceding years and has been found off and on in Louisville since record collection began in the early 1960's.

Although the overall species distribution did not deviate greatly from previous years (*Ae. vexans* is still the most numerous), there are several items that are noteworthy in the general numbers in Table 2. First, the overall number of mosquitoes for 2008 (11,455) is up substantially relative to last year and higher than the previous years. Though the increase is not the dramatic 10-fold increase seen with the larval counts, the increase in adults does mimic the pattern seen for larvae in Table 1.

Secondly, we saw the *Cx. pipens/restuans* complex return to its more typical relative level of 2.7% (318/11455). Last year, I expressed concern that the *Culex* complex had increased relative to other mosquitoes (overall 6.7% of the specimens received in 2007) and explained how it might have been drought-related. It was encouraging to see that, with the more normal rainfall pattern of 2008, the *Culex* complex retreated to its lower relative level.

I also noted in last year's report, the re-appearance of *Cx. nigripalpus*. In 2008, this species appeared to gain ground in both absolute terms and as a proportion of overall mosquito species collected. It has come from being rare (a total of only 4 specimens had been found in Louisville since 1960) and long-absent (the most recent specimen had been collected in the early 1970's) in 2006 to being the 6th most numerous species in 2007 and the 5th most numerous species in 2008. Moreover, whereas we found this species in only two locations in Louisville during 2007, they were collected from 22 locations in 2008. They were also collected through the season from the end of May through September.

I expressed concern about this species in 2007 and am more alarmed by the 2008 data. After consulting with Dr. Fred Knapp who has been a medical entomologist in Kentucky since the 1950's, the last time there was a significant surge in this species was likely just prior to the St. Louis Encephalitis outbreaks in the 1950's. We also know that, in South Florida where this species is most numerous, it is the principle vector of SLE. Fortunately, no positive pools of SLE were reported in Kentucky in 2008 but the vector potential is clearly building. It is important to monitor this species very closely for possible SLE activity in 2009.

Table 2 shows a continuing decline for *Oc. japonicus* that I reported last year. This odd species is beginning to look like it will be very spotty in Kentucky. In some areas far from rivers, it is still quite rare while in some river cities (e.g. Cincinnati), it can be one of the most important *Aedes* spp. Apparently, in Louisville, though it appears to be establishing itself as a minor species. There are many aspects of this species biology and ecology that are understudied but, as of now, we are much less concerned with it in Louisville than we have been in previous years.

With respect to the locations, the location-specific diversity of the identified species was similar to previous years. In particular, the Outerloop Landfill, Rossmoor, and Transmission Lines sites were the most diverse and had the most unusual species. This result is similar to that observed for 2007.

WEATHER RELATED ACTIVITY

Louisville experienced slightly less than average precipitation in 2008. From May 15, 2008 to October 15, 200, Louisville experienced 17.44 inches of rainfall and this was 1.01 inches below normal for this time period. For comparison, during the same period in 2006, there was more than 27 inches of rain (http:// wwwagwx.ca.uky.edu) but about 6 inches less in 2007. In 2008, there was measurable rainfall (> 0.01 inches) on 51 of the 152 days from May 15 to October 15 while, for a comparable period in 2007, there was measurable rainfall for only 32 days. It is probable that the increased number of mosquitoes identified during 2008 compared to 2007 is due, at least in part, to the increased availability of water in 2008.

OTHER ACTIVITIES

We continued to give interviews in the popular press on mosquito control and current research. These interviews generated a large number of phone calls from citizens with questions about mosquito management as well as a few requests for presentations to neighborhood association meetings, which we provided.

I reported on the appearance of phlebotomine sand flies in Kentucky in my 2007 report. In 2008, we found the first specimen of *Lutzomyia shannoni* from Louisville and this is a new record. That specimen was collected at the Transmission Lines on Aug. 29, 2008. The populations of this species normally peak in late August or early September in other parts of Kentucky. As noted before, this species vectors a number of important diseases and continues to increase in range and prevalence throughout Kentucky.

We also conducted extensive testing of a new larvicide from Clarke Mosquito Control – Natular. It is a spinosad-based product that can be applied to likely mosquito breeding sites (e.g. catch basins) and, depending on formulation, can provide extensive mosquito suppression for up to 150 days. We evaluated some 15 formulation/rate combinations against over 20 species and found them to all be effective. It has a group 5 mode of action and is the only insecticide labeled for use with that mode of action class. As a result, I believe that it should be considered as a rotational product in a larviciding program.

SUMMARY AND RECOMMENDATIONS

The most serious nuisance species in Louisville continues to be *Ae. vexans* . At present, this species does not often transmit diseases to humans but it is a primary vector of canine heartworm and is a competent vector of many other diseases. Thus, it represents a continuing threat to Louisville residents and their canine pets.

The most serious disease threat in Louisville continues to be *Cx. pipiens/ restuans* but it has been joined by a new and equally serious species, *Cx. nigripalpus*. It appeared for the first time in Louisville in 2007 and increased its numbers significantly in 2008. Where this species is prevalent, it is the dominant SLE vector and the last time that we saw it in numbers like this, we saw a large number of human SLE cases.

My recommendations for 2008 activities are as follows:

1. The sites with the greatest mosquito diversity should continue to be sampling sites, particularly the Outerloop Landfill, Rossmoor, and Transmission Lines. These sites produce the most mosquito species, the most genera, and the greatest numbers. Further, they also produce the largest number of medically-important mosquitoes.
2. Adult and larval mosquito surveillance methods should continue as in 2008. The Louisville mosquito management program is the best in the state and is one of the longest operating programs in the country. In fact, in many ways, it is a model of a municipal program. The key to its success is its excellent surveillance program. This aspect of the program must continue.
3. We offered the mosquito identification course to offer again in 2008 and will do so again in 2009. We will announce the availability of that course soon and will probably schedule it for the first week in May, as we did last year.
4. We will continue to monitor the sandfly situation throughout the state.
5. I recommend that we take a few extra samples in the Transmission Line and Moravian sites in mid-late August for the specific reason of conducting SLE virology on *Cx. nigripalpus* pools. The Public Health Entomology Laboratory would be pleased to help in that effort.

Finally, I would like to note that the American Mosquito Control Association will meet in Lexington, March 31 – April 3, 2010. Approximately 800 mosquito control professionals (primarily from municipalities) will be in attendance and it is an excellent opportunity for the Louisville program to receive attention. The University of Kentucky Public Health Entomology Laboratory will host this meeting and I would welcome the opportunity to discuss ways in which Louisville could benefit.

The cooperation from Connie Mendel, Ed Galligan, and all of the people in the Department was excellent and very beneficial throughout 2008. Their help is much appreciated. We have also been assisted this past year by several students in the Public Health Entomology Lboratory. We thank them all.

I look forward to continuing in this capacity in 2009 and hope that my services have proven useful.

Respectfully Submitted, Grayson C. Brown

Table 1. Mosquito larvae identified from Jefferson County in past five years (2004-07). Species names with a double asterisk (**) were found in 2008 for the first time in the five year period.

Mosquito Species	**Year of Surveillance**				
	2008	**2007**	**2006**	**2005**	**2004**
Aedes albopictus	15	8	73	84	13
Aedes vexans	174	8	116	85	592
Culex restuans	1048	0	83	61	161
Culex pipiens	0	0	32	13	130
Aedes spp.	0	0	12	9	8
Anopheles barberi **	1	0	0	0	0
Anopheles punctipennis	8	0	0	0	1
Anopheles quadrimaculatus	4	0	1	0	2
Culex erraticus	0	0	2	0	7
Culex pipiens/restuans	192	60	6	5	3
Culex spp.	0	0	63	50	45
Culiseta inornata **	26	0	0	0	0
Ochlerotatus atlanticus	0	0	0	0	2
Ochlerotatus canadensis **	32	0	0	0	0
Ochlerotatus hendersoni	0	4	0	0	3
Ochlerotatus japonicus	4	0	27	0	22
Ochlerotatus sollicitans	0	0	0	0	1
Ochlerotatus triseriatus	7	0	12	0	102
Orthopodomyia signifera	1	0	0	0	7
Psorophora columbiae	0	0	0	0	1
Psorophora ferox	0	0	1	0	1
Psorophora horrida	0	0	4	0	13
Psorophora howardi	0	0	2	0	19
Toxorhynchites rutilus **	2	0	0	0	0
Larvae < 4th Instar	**1198**	**148**	**32**	**28**	**0**
Unknown Larvae	**84**	**4**	**3**	**5**	**0**
Unknown Pupae	**254**	**7**	**NA**	**31**	**0**
Damaged Samples	**0**	**6**	**0**	**11**	**0**
Total	**2972**	**239**	**469**	**381**	**1133**

Table 2. Mosquito adults identified from Jefferson County in the past five years (2005 – 2008). Species marked with a double asterisk are new this year.

Species	**Year of Surveillance**				
	2008	**2007**	**2006**	**2005**	**2004**
Ae. vexans	7867	1518	2974	2307	3599
Ae. albopictus	104	306	99	52	53
Unknown and males	1962	178	22	5	0
Cx. pipiens/restuans	318	165	92	77	84
An. punctipennis	141	64	27	46	63
Oc. sp.	0	55	2	2	0
Cx. sp.	15	24	11	2	6
Cx. nigripalpus	215	24	0	0	0
Ae. sp.	2	23	15	2	11
Oc. triseriatus	79	20	21	15	21
Ur. sapphirina	62	16	6	19	54
An. quadrimaculatus	94	15	37	9	57
Ps. howardii	6	10	0	0	0
Coq. perturbans	11	9	1	17	2
Oc. j. japonicus	2	6	33	4	0
Oc. grossbecki	13	3	0	0	0
Cx. erraticus	264	2	53	20	53
Or. signifera	2	2	0	3	0
Cx. territans	0	2	9	2	24
Ps. Ferox	1	1	21	35	19
An. crucians	272	1	9	1	35
Ps. Sp	0	1	0	1	8
Oc. sollicitans	0	1	0	0	0
Oc. trivittatus	0	0	58	81	80
Toxo. rutilus	0	0	1	9	0
Oc. c. canadensis	18	0	0	2	0
Psorophora ciliata	0	0	0	0	4
Psorophora columbiae	0	0	0	0	13
Psorophora cyanescens	6	0	0	0	1
Psorophora horrida	1	0	0	0	0
Aedes cinereus	0	0	0	0	1
An. sp.	0	0	2	0	8
Totals	**11455**	**2445**	**3605**	**2770**	**4245**

Attachment B

2008 mosquito control treatment Department of Codes and Regulations

IPL baited approximately 50 properties (swimming pools) in 2008. IPL also eliminated standing water by dumping out buckets, garbage can lids, and anything else that is found holding water can be easily lifted. IPL cites all property owners for any standing water issues that cannot be easily eliminate (e. g., tires, rubbish, or clogged gutters, etc). IPL typically get compliance from the owners after they are cited.

IPL's main focus for mosquito control is on abandoned properties with swimming pools or decorative ponds with water standing water. An IPL representative attempts to return to these properties every 30 days. Occasionally, IPL will treat standing water issues in open basements. Many of these properties are the result of fires. IPL does not treat streams or ponds. All other mosquito complaints are referred to the Louisville Metro Department of Public Health and Wellness Mosquito Control Division.

Attachment C

2008 mosquito control treatment Metro Parks

METRO Parks

Michael J. Heitz, AIA
Director

1297 Trevilian Way
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Louisville, Kentucky
40233-7280

tel 502/456-8100
fax 502/456-3269
tdd 502/456-8183

b www.metro-parks.org
il parks@louisvilleky.gov

January 21, 2009

MEMORANDUM

TO: Marty Storch, Jason Cissell, Jacky Gardner, Brian Haag

FROM: Ann C. Yates

SUBJECT: 2008 Mosquito Treatment

In the West Region, Cherokee, Iroquois and Shawnee Districts did no mosquito treatment.

The Sun Valley District treated Watterson Lake and the Rosenberger estate once in May and once in July.

The sheets for the East Region are attached as they have multiple dates and places.

If you need further information, let me know.

Attachments

Metro Parks
East Region
Mosquito Treatment

District A.B. SAWYER

Date	Park/Location	Area Treated	Amount Used
5-9-08	CROSBY PK.	STANDING WATER BEHIND BALL FIELD	12-PKS
5-9-08	~~LONG RUN~~ HAYS	WATER NEAR PK. LOT + PLAYGROUND	24-PK.
5-21-08	LONG RUN	WATER BEHIND BALL FIELD BEHIND RESTROOMS	12-PKS.
6-21-08	HAYS PK.	WATER NEAR PK. LOT + PLAYGROUND	30-PKS
7-8-08	HAYS PK	" " "	2-BAGS
7-9-08	CROSBY PK	STANDING WATER BEHIND BALL FIELDS	18-PKS.
7-9-08	LONG RUN	BEHIND RESTROOMS	6-PKS.
8-21-08	LONG RUN	" "	6-PKS.
8-21-08	CROSBY	STANDING WATER BEHIND BALL FIELDS	12-PKS
8-21-08	HAYS II.	BEHIND BALL FIELD FENCE	24-PKS.

Supervisor's Signature [signature]

Date 1-21-09

Metro Parks
East Region
Mosquito Treatment

District Vetlines

Date	Park/Location	Area Treated	Amount Used
6-2-08	Highview	Behind parking lot - woods area	5 bags
6-2-08	Vetlines	Behind restrooms	3 bags
6-2-08	McNeely Pk	East of lake - standing water	15 bags
6-5-08	Okolona	pitch line south border of PK	5 bags
7-14-08	Highview	Behind parking lot - woods area	3 bags
7-14-08	mcNeely PK	east of lake, along path, standing water	10 bags
7-15-08	Vetlines	~~Behind~~ Behinds restroom	3 bags
7-15-08	Okolona	Ditch line, south border of PK	5 bags
8-20	McNeely PK	East of lake	8 bags
8-21	Highview	Behind parking area woods	2 bags
8-21	Okolona	Ditch line	3 bags
8-22	Vetlines	Behind restroom	1 bag

Supervisor's Signature KRParker

Date 8-25-08

Metro Parks
East Region
Mosquito Treatment

District CREASON

Date	Park/Location	Area Treated	Amount Used
6/2/08	Cox	WEST PARKING LOT	6 PKGS
"	Cox	CENTER PARKING LOT	4 PKGS
"	Cox	EAST " "	6 PKGS
6/5/08	G. ROGERS	NEAR CREEK, McKINLEY SIDE	6 PKGS.
6/24/08	C. TAYLOR	DITCH LINE	6 PKGS
6/25/08	Cox	WEST LOT	6 PKGS
"	"	CENTER "	4 "
"	"	EAST "	6 "
7/21/08	C. TAYLOR	DITCH LINE	6 "
7/22/08	Cox	WEST LOT	6 "
"	"	CENTER "	4 "
"	"	EAST "	6 "
7/30.8	"	WEST "	6 "
"	"	CENTER "	4 "
"	"	EAST "	6 "
"	C. TAYLOR	DITCH LINE	6 "

Supervisor's Signature Sam Rapp

Date 1-20-2009